IV.

CLINICAL, ANATOMICAL, AND BRIEF HISTOLOGICAL DESCRIPTION OF TEN CASES OF FEEBLE-MINDEDNESS.

With Thirty-Two Plates (Waverley Research Series XI–XX).

E. E. Southard, Oscar J. Raeder and Annie E. Taft.

The present paper and the one which follows it form the second instalment of the Waverley Researches in the Pathology of the Feeble-Minded. The first instalment pub lished in May, 1918, dealt with Cases I to X, published in three papers.[1] The second instalment deals not only with the details of Cases XI to XX but has led to some general considerations concerning the entire series, Cases I to XX. It may be well to repeat that the editors have set a provisional terminus for the work at a series of fifty cases, the anatomical material for which is already largely in hand. The epicritical remarks which we intend to present by the way are after all nothing but *ballons d'essai*. Above all it must be insisted that the problem of the pathology of the feeble-minded is not a problem of the brain alone, but that all experience increasingly indicates that the problem of feeble-mindedness is in many ways a problem of pathology at large and in particular of that pathology of the endocrine glands which remain still so obscure.

We found our major brain problems in the first series (Cases I–X) in

a) the correlation of mental and cerebral measurements, and

b) the theoretically preventable group of feeble-mindednesses (e.g., syphilitic and post-poliomyelitic).

Both of these problems appear in stronger relief in the present series (Cases XI–XX) but the problem which we termed in 1918 *the* problem, namely, of *matching testable mind with measurable brain*, stands out so sharply that it has been thought best to place its discussion in a special paper following this.

[1] I. General Aspects of the Brain Anatomy in the Feeble-Minded, with Partial Bibliography. E. E. Southard.
II. Clinical, Anatomical, and Brief Histological Description of Ten Cases of Feeble-Mindedness, with 84 plates (Waverley Research Series, Cases I–X). E. E. Southard and Annie E. Taft.
III. Neuropathological Correlations with Clinical and Psychometric Findings in Feeble-Mindedness (Waverley Research Series, Cases I to X). E. E. Southard and Annie E. Taft.

We may refer to the preface of the former monograph for more general considerations, to Waverley Researches, article I, for a brief analysis of the general situation as regards brain anatomy in feeble-mindedness, to Waverley Researches, article II, *ad init.*, for the general plan of our descriptions and to Waverley Researches, article III, for certain general tabulations of the data in Cases I–X which we shall attempt to follow in our account of Cases XI–XX. The description of photographs is placed after article V, the plates being provided with Roman numerals to correspond with the cases shown.

For a brief characterization of each of the ten cases in the present group of the Waverley Research Series, reference may be made to the latter part of this paper. For more general considerations, reference is made to article V.

We now proceed to a condensed description of the findings in Cases XI–XX of the Waverley Research Series following the same plan of description employed in the preceding group. For convenience we offer a table which shows a number of facts about each case, chiefly of a catalogue nature.

TABLE VII.[1]

TABLE OF GENERAL AND CATALOGUE FEATURES.

CASES XI–XX.

Research Series number	Clinical Source number	Local Autopsy number	Harvard photographic number	Sex	Actual Age	Assigned Mental Age	Height last taken	Brain Weight, grams	Brief designation
XI	W. 441	S.B.I. 14.76	15.4	M	5 10/12	1.2	102	820	Hydrocephalus
XII	W. 2625	S.B.I. 15.48	15.18	F	20	3.4	148	2325	Hydrocephalus
XIII	W. 2677	S.B.I. 15.67	15.24	F	18	3.1	139	1160	Mongolian
XIV	W. 1910	S.B.I. 15.73	15.25	M	32	1.3	159	1205	Idiot
XV	W. 4753	S.B.I. 15.14	15.26	M	43	2.4	152	1070	Imbecile
XVI	W. 3137	S.B.I. 15.104	15.31	M	14	1.0	128	950	Macrogyria
XVII	W. 4203	S.B.I. 15.111	15.41	F	31	7.0	160	1275	Imbecile
XVIII	W. 4282	S.B.I. 15.125	15.48	M	9	1.0	115	1475	Idiot
XIX	W. 4300	S.B.I. 15.140	15.64	M	23	5.2	160	910	Mongolian
XX	W. 2208	S.B.I. 15.110	16.3	M	38	6.0	168	1390	Insane Imbecile

W. = Waverley (Massachusetts School for the Feeble-Minded).

S.B.I. = Massachusetts State Board of Insanity and refers to cases autopsied since the establishment of the Pathological Service of that Board, July 1, 1914.

As to the assigned mental ages, reference is made to the detail of the clinical findings.

The following brief comment on the items of our description already given in Volume I is repeated here for convenience of the reader. The items in general are:

a. Clinical Findings.

b. Autopsy Findings.

[1] The numbering of these tables is consecutive with the tables in the First Series of Waverley Researches, the last table of which was Table VI, pp. 118–119.

c. Special Description of Brain.
d. Partial Microscopic Description.
e. Anatomical and Histological Summary.

As to *a. Clinical Findings:* These have been arranged so far as possible to follow a scheme employed at the Massachusetts School for the Feeble-Minded and originated by Dr. W. E. Fernald. The headings are ten in number, as follows:

1. Physical Examination.
2. Family History.
3. Personal and Developmental History.
4. History of School Progress.
5. School Examinations.
6. Practical Knowledge.
7. Economic Efficiency.
8. Social History and Reactions.
9. Moral Reactions.
10. Psychological Tests.

Following the items thus arranged are notes, usually brief, concerning the institutional history, if any, of the patient.

As to *b. Autopsy Findings:* These are limited to the gross anatomical findings of the examiner as made on the autopsy table. Their results are more systematically given in table form in Article V.

As to *c. Special Description of Brain:* The data are founded upon examination, as a rule, subsequent to the autopsy and to the preservation of the brain, which has been in all cases in 10% formaldehyde solution, in many cases for relatively long periods, which are obvious from the dates included in the descriptions. As a rule, the special brain description has had the advantage of comparison of the brain specimen itself with the photographs, systematically taken, of the brain before and after stripping the pia mater. These descriptions are largely the product of Dr. Taft, who has personally stripped each brain of the pia mater, preserving the pia mater in certain cases where there was question of important lesion therein. The nomenclature is, as a rule, self-explanatory and follows largely the nomenclature of Quain's Anatomy.

As to *d. Partial Microscopic Examination:* It must be insisted that this is really but partial and has no pretensions to the completeness which the resources of a modern laboratory will eventually command. Nevertheless, we have resorted in each instance to total brain sections stained by the Weigert myelin sheath method in our estimates of the fibre

content of the brain. The resulting estimate is, as a rule, entirely qualitative. But it may be questioned whether it is possible at this time to make more than a qualitative estimate of fibre contents. The total brain sections stained by the Weigert method have been of value in the estimates of the depth of the corpus callosum, as well as for the purpose of discovering special periods of degeneration or faulty development of fibre systems.

We have, also, employed staining methods for the study of cortical architecture, employing as a rule cresyl-violet in place of thionin and methylene blue. This sharp nuclear stain has permitted us in most cases to make a profitable study of the cortical lamination, as well as to bring out the exudate about vessels where exudate is present. As will be emphasized in Article V, the existence of exudate in more cases than had been at first suspected is probably of importance from the genetic standpoint, since syphilis or some kindred chronic inflammatory condition may be suspected in cases with such exudate. Again, we have been able to observe rod cells in certain cases, which cells again tend to indicate a more progressive condition than has been considered typical in cases of feeble-mindedness. In suitable cases, we intend to make special topographical studies of cortical laminations. This we have in hand in chosen instances, and the resulting descriptions are intended to appear in later articles in this series. For the present, as will be evident from Article V, we have limited our microscopy to the question of exudate, rod cells, and the like, on the one hand, and to qualitative estimates of cortex lamination, fibre content, on the other.

As to *e. Anatomical and Histological Summary:* We have attempted to bring out the main structural points in each case, with, however, little or no attention to the total genetic picture presented by the case. This total genetic picture is reserved for Article V.

Further light upon the anatomical situation presented by each brain is offered in the description of the plates. The most inclusive view of each case from all available aspects: clinical, anatomical, histological, and genetic, together with points especially mentioned in the description of the plates, is given in Article V.

Synopsis of Findings of Case XI.

a) Clinical.[1]

1. Physical Examination.—J. K. Born February 10, 1909, and died November 29, 1914; admitted at 3 years, 9 months of age, November 16, 1912. Upon admission he was found to have a very large head, cranium broad and flattened in occipital region; was under-sized; at 5 years the patient

[1] The clinical findings have been arranged to follow a scheme employed at the Massachusetts School for the Feeble-Minded and originated by Dr. Walter E. Fernald, a general account of which has been given in Mental Hygiene, "Standardized Fields of Inquiry for Clinical Studies of Borderline Defectives," Vol. I, No. 2, April, 1917.

weighed 36¼ pounds and was 3 feet, 3 inches in height. Vision was defective, hearing normal; circulation was poor; extremities showed spastic paralysis, involving the muscles of the left arm, and of the right leg. The left face was paralyzed; there was toe-drop on the left side; patellar reflexes were increased on the right side. The upper lids of the eyes were kept habitually drawn up. Tonsils were enlarged; teeth poorly developed and nourished, and decayed to the gums. Parents of the patient were Irish-American.

2. **Family History.** Patient's father was 27 years of age and mother 22 years when patient was born; patient was the first child and mother's health was good during pregnancy. Mother a working-woman, supporting two other children who are stated to be normal; the mother did not know the whereabouts of the father as she had left him on account of confirmed drunkenness. The patient was visited by the mother at frequent intervals.

3. **Personal and Developmental History.** Patient had learned to say a few words, was helpless, could not walk or feed himself; untidy both day and night; there was a history of convulsions before admission but patient had none at the School. It is stated that patient's head began to enlarge when he was about 3 months old. There was a history of severe forceps injury and hemorrhage from the ears at birth. Spastic paralysis was stated to have developed after a period of severe convulsions. Patient was able to sing songs that he had heard once or twice, could remember an entire verse of a popular song such as "School Days"; patient understood what was said to him but if asked questions, was apt to repeat the question.

4. **History of School Progress.** Nil.

5. **School examinations.** Nil.

6. **Practical Knowledge.** Nil.

7. **Economic Efficiency.** Nil, except as stated under Physical Examination, (see above).

8. **Social History and Reactions.** Patient learned the names of all the children in the hospital; he spoke of one girl who had died, saying "she has gone to heaven."

9. **Moral Reactions.** Disposition happy, generally talking and singing. If moved or disturbed, patient seemed to feel discomfort and would cry.

10. **Psychological Tests.** 1.2 Binet examination performed June 22, 1914.

Waverley School History. Patient was taken acutely ill November 3, 1914, with high fever, pulse and respiration; temperature 102, later 100, and dropped to subnormal after 3 weeks. Death after 3 days of subnormal temperature; consciousness preserved up to one week before death; food taken up to last day. Occasional coughing; no opisthotonos or retraction of abdomen.

b) Autopsy.[1]

Body of a poorly developed child, fairly nourished, 102 cm. in length. Skin over arms wrinkled. Skin brawny over abdomen and extremities.

Measurements:	Circumference of chest at flare of ribs	50.7 cm.
	Circumference of chest at level of 3rd ribs	49.0 cm.
	Right arm at mid biceps	12.7 cm.
	Left " " " "	10.4 cm.
	Right wrist	9.9 cm.
	Left "	9.4 cm.
	Right leg mid thigh	20.5 cm.

[1] The autopsies in the present series were performed by Myrtelle M. Canavan, In Charge of the Pathological Division, Massachusetts State Psychiatric Institute.

Left leg mid thigh	19.4 cm.
Right knee	19.5 cm.
Left "	19.0 cm.
Right mid shin	13.5 cm.
Left " "	14.3 cm.
Length both feet plantar surface with toes extended	13.5 cm.
Neck measurement	22.8 cm.
Mento-bregmatic	10.9 cm.
Bimastoid	43.5 cm.
Mento-occipital	47.5 cm.
Circumference of head	66.7 cm.

The right leg is shorter than the left by 1.5 cm. The left arm is contractured, a "web" at angle of left elbow 2.5 cm. in depth. Thenar eminences flat. Penis rudimentary is 2.5 cm. in length. The scrotum is indicated by a few transverse wrinkles of skin, measures 3 × 3 cm.; color and consistency same as other portions of body. Dorsum of feet show some edema.

Weight of body 28 lbs.; head approximately 10–15 lbs.

Pupils — right 0.6 cm., left 0.4 cm. Eyeballs appear sunken.

Ventral Section.— Fat over abdomen 0.8 cm., over chest 0.4 cm. *Omentum* in a fern leaf pattern of fat distribution, is attached to descending colon. Spleen is adherent on external surface. *Appendix* has a mesentery of its own for entire length is 8.0 cm. in length. *Mesenteric lymph nodes* not enlarged except small ones in mesentery in coecal region. Diaphragm arches to 4th rib on right, 5th on left.

Thorax.— No free fluid in the thoracic cavities. Lungs free.

Heart.— Weight, 40 grams. 6 × 6 cm. Myocardium somewhat firm. Endocardium slightly edematous.

Measurements: T. V. 6.5 cm. P. V. 4.0 cm. L. V. 0.6 cm.
M. V. 6.5 cm. A. V. 4.5 cm. R. V. 0.2 cm.

Coronaries show no sclerosis.

Lungs.— Combined weight 225 grams.

Lower lobe of left lung is granular on its pleuric surface and dark red in color. It sinks in water. Section shows splenized appearance — some injection about bronchi which are thickened in their walls. There are definite collections of puriform material, stained smear from which shows no tubercle bacilli but polynuclear cells which show definite diplococci in pairs.

Organs of the Neck.— *Thymus* remains easily traced. *Thyroid* not examined.

Abdomen.— *Spleen.* 55 grams. Measures 10 × 5.5 × 1.0 cm. There are five foetal lobulations on external border. Pulp firm. Malpighian bodies numerous. Trabeculae not prominent.

Adrenals.— Small; negative in appearance.

Kidneys.— Weight 110 grams. 7.5 × 2 cm.

The left cortex measures 0.4 cm. Pyramids are white at apices. Pelvis much dilated and contains many gritty concretions near the apices in the calices. The ureter from this kidney is dilated and injected but not thickened. Right kidney same general description but the pelvis is not so injected, containing only one concretion. Some of the apices are entirely white.

Liver.— Weight, 340 grams. Measures 16 × 8 × 3.5 cm. Color brown-red. Gall bladder negative.

Pancreas.— Appears normal on section.

Gastro-Intestinal Tract.— *Stomach* dilated; no rugae present. Mucous surface looks glossy. Remainder of tract negative.

Genito-Urinary Tract.— Bladder contains a quantity of gritty brown mossy material but trigone and openings of ureters negative.

Prostate and testes not examined.

Retroperitoneal Tissues.— Aorta small and smooth. No lymph nodes seen near it. Thoracic duct and its receptaculum seen.

Head.— *Hair* yellow, somewhat dry and coarse but fairly abundant except over occipital region where it is worn off short. The scalp is oily and very thin but elastic.

Skull.— The color is irregularly blue with red points of injection. There are also white areas appearing between the sutures. On either side of the junction of the sagittal and coronal sutures are depressions and softenings of the cranium. The depression on the right appears to be an opening of the coronal suture externally to the limits of the fontanelle and measures 4 × 0.5–1.0. The one on the left is 2.5 cm. from the median line. Another depression which is soft allows the tip of the index finger to be placed in it and measures 3 × 0.8 cm. at one extremity and 1.5 × 1.3 cm. at another. This goes somewhat forward and outward on the suture angle and extends into the frontal bone. Surrounding these softened areas the calvarium is white in relief to the blue color and injection of the frontal portion. Following the sutures to the right are inserts of bone and white tracery surrounds these inserts; these supernumerary or Wormian bones measure 2.5 × 2.5 and 1.5 × 1 and 2.5 × 1.5 respectively and are situated in the coronal suture. No others seen in the sagittal and none in the lambdoidal suture.

The *calvarium* measures, *frontal, temporal* and *occipital* 0.2 cm. in thickness. Holding the calvarium to the light, the thickest portion is on either side of the longitudinal fissure and somewhat irregularly along the middle meningeal distribution. It is thinnest in the frontal portion at vertex above mentioned and in the superior occipital region. The left frontal eminence is more prominent than the right and the whole vertex on the left appears slightly higher than the right but anterior to the parietal bosses are slightly deeper depressions made evident by the bulging of the parietal bosses. The inequality of the parietal bosses not as marked as the frontal inequalities. Temporal muscles thin and undeveloped.

Dura is not adherent to the calvarium except slightly at vertex. The dura is thin, allowing brain convolutions to be readily seen through it. The dura is adherent to the pia in the right parietal region for a distance of 4 × 1.5 cm. along the anterior portion of the sylvian fissure and for the focal area 1 × 1.5 over the foot of the second frontal convolution, 4 cm. from the mid line on the right side.

Before the calvarium was removed, the brain was sawed into and a clear white fluid poured out to the extent of 84 fluid ounces (2380 cc.).

Pia is injected and the brain measures 20 cm. wide × 22 cm. long on the left hemisphere, approximately the same on the right. There is a suggestion of an occipital pole on the left but the right is a mere sac. The longitudinal sinus contains a little antemortem clot. The corpus callosum is present and is a translucent membrane 3 cm. in width at its posterior 3rd. There is direct communication from side to side of the lateral ventricles and the ventricles extend to the limits of the cortical covering of the brain.

Base of the brain. The olfactory bulbs are free but the posterior two-thirds of the olfactory tract are bound down firmly to the brain surface by a yellowish fibrinous exudate. This exudate is plainly visible in the circle of Willis and surrounds the 2nd, 3rd and 4th nerves, leaving the right 5th nerve free but involving the left 5th nerve. This exudate follows the basilar artery and the vertebrals and surrounds the medulla, closing entirely the 4th ventricle and covering the cerebellar notch, also appearing at the base of the cerebellum and following the small vessels over the hippocampal gyrus on the left but not on the right. This exudate which is massed at the base of the brain follows the Sylvian fissures, obliterating them. The cerebellum resumes a central position for the measurements at the base of the brain which are 22 × 18 cm. The cortex is greyish yellow in color. Pia injected. The thickness of the cortex is 0.1 over the right occipital region and over the right temporal portion anteriorly.

The left side of the brain appears to have more substance to it than the right, especially to be noted in the temporal lobe which has a palpable depth of 2.0 cm. against a palpable depth of 1.0 cm. on the right. This palpable depth on the right is thought to be due to extension of the tuberculous process at the base.

Cerebellum measures in greatest width 10.5, greatest anteroposterior diameter 5.5 and it is 2.5 cm. in thickness. With the exception of some shortening of the left lobe, the cerebellum has a fairly normal appearance. On palpation the left hemisphere is firmer than the right. The *posterior portion of the sella turcica* is membranous and the fossa itself is shallow. There is a small posterior nervous portion of the pituitary and the glandular portion is deep red.

Ear drums opaque.

Gasserian ganglia negative.

The optic disc of the right eye shows edema at its base. Vessels before division in central portion appear raised from the center. Disc of the left eye similar to right but circumference less.

Brain weight, (820 grams). (This brain still contains some of its fluid.)

Spinal Cord.— Underneath the dura the cord is bathed in yellow pus situated between the pia mater and the cord. In the middle of the thoracic portion there is a bloody mixture in the pus. The pia mater is lifted from the cord for a distance of one half cm.

Fluids from the (a) pericardial sac.
(b) free fluid from the ventricles,
(c) base of the brain,
(d) 3rd ventricle,
(e) spinal canal,
give reactions to the colloidal gold test.

A smear from the exudate at the base of the brain shows a marked display of large phagocytic cells which are in some instances enclosing other cells and in many cases enclosing brilliantly stained *tubercle bacilli.*

A smear from the pus in the lung substance is negative for tubercle bacilli but does show large numbers of polynuclear cells many of which contain diplococci.

Gold sol reactions were observed in fluids withdrawn post mortem and the fluid from the base of the brain showed a typical tuberculous reaction, 0 0 0 0 0 1 2 2 1 0.

The fluid from the ventricles was somewhat suggestive of tuberculosis (0 0 X/2 2 2 1 0 0 2?).

The fluid from about the spinal cord would be interpreted as either septic or tuberculous 1 1 1 1 1 1 1 2 3 3).

Anatomical Diagnosis (General Appearance and Anomalies).

Poor development.
Poor nutrition.
Brawny skin.
Inequalities of measurements of limbs with contracture of left arm and shortening of right leg.
Penis undeveloped.
Head hydrocephalic with anterior fontanelle not completely closed and with Wormian bones.
Calvarium thin and of unequal thickness.
Oily scalp.
Unequal pupils.

Acute lesions.

Bronchopneumonia (not proved tuberculous).

Tuberculous meningoencephalitis with hydrocephalous injection of pia mater and lesions most marked in the basilar region.

Retinal inflammation.

Tuberculous spinal meningitis.

Brain weight 820 grams.

Chronic lesions.

Renal stone with hydroureter.

c) and d) Special Description of Brain and Microscopic Examination.

The measurements of the brain are given under the autopsy description.

Microscopic sections were made from right hemisphere as follows:

Section from the parolfactory region shows very well the exudate on the base of the brain. This surrounds the vessels of the adherent pia and is made up of lymphoid cells and large phagocytic mononuclear cells and fibrin,— a similar exudate surrounds the vessels in the overlying brain tissue. The endothelial layer of the pial vessels is swollen, and in some places lifted from the underlying layer,— among many others the cells have infiltrated the muscular layers of the vessel wall. There is extreme proliferation of all forms of fibre-bearing cells, many of which have considerable protoplasm. There are foci of cell infiltration of the exudative type in the subependymal tissue where there is also much glia cell and fibre increase. The ependymal cells appear to be proliferating.

The wall of the hemisphere in the calcarine region was in places only 6.0 mm. in thickness. The pia mater over this region was thin and closely adherent to the cortical substance. It was impossible here to study the microscopic conditions of the brain without reference to acute lesions. The characteristic lamination of the calcarine cortex was distinct and the solitary cells of Meynert were in evidence. There is, however, a certain degree of cell scarcity. Most of the nerve cells have a shrunken appearance so that the nuclei appear large in proportion to the cell bodies. The apical processes of the nerve cells are often wavy. There is a general tendency to chromatolysis, very possibly due to the acute lesions in the brain. Upon the ependymal surface of the section there is a marked cellular gliosis not unlike the cellular gliosis described above for the parolfactory region. The vessels of the white substance are surrounded with exudative cells and along the capillaries there is a good deal of glial " beading."

The frontal region, for example, in the superior frontal gyrus is still thinner and in places no thicker than 3 mm.; here the thinning out of cells is everywhere well marked but more notable in the outer layers. There is some sort of glial reaction as described elsewhere. The perivascular reaction is slight.

Sections from the inferior parietal area show a more moderate thinning out of the cells and the superior parietal region in general resembles the inferior parietal. There is a marked perivascular exudate of the vessels near the ventricular wall.

A section from the angular gyrus presents the same appearance as those of the inferior parietal area.

Concerning the sections in general, there were observed many small collections of cells in the white substance beneath the ependyma. These cells were chiefly large mononuclear cells of the endothelioid type. Occasionally these cell collections had grown large enough to make a "granule" or miliary tubercle on the ependymal surface. These groups of cells were usually found to stand in close relation with a blood vessel.

The ventricles are enormously dilated so that a shell of grey and white matter surrounding at top and sides measures less than 2 mm. to 7.0 mm. and in other regions from 3 mm. to 1.5 cm. The brain matter surrounding the inferior horn measures as low as 0.5 mm. to 2.5 mm. on the right side, and from 1 mm. to 6 or 7 mm. on the left, so that the process of hydrocephalic dilatation is slightly greater on the right. (See plates for gross sections.)

The white matter is pressed out against the grey so that in areas of extreme stretching it consists of only a thin band underlying the cortex. The flattened caudate nucleus is distinctly separated from the lenticular nucleus, which is also flattened by a thick internal capsule in which the fibres are closely crowded upon each other. The external capsule is plainly demarcated, and the cornu ammonis is relatively intact though considerably flattened and reduced in size. There is no other evidence of fibre degeneration.

Cerebellum.— The fourth ventricle is extensively dilated in a section through superior peduncle,

1.7 cm. to 2.5 cm. There appears to be a slight thinning out of the medulla. The neighboring tissues are slightly distorted by the dilatation of the fourth ventricle.

The bulb and cord besides showing the exudative meningitis more marked on the posterior surface (with cell types like those seen elsewhere) also show evidence of a more chronic lesion, namely, a " greying-out " of one of the pyramids and of one lateral column (pyramidal tract). The sections of the cord show an appropriate unilateral reduction in the fibre bundles making up the pyramidal tract. This lesion corresponds with the inequalities in thickness of brain substance noted in the autopsy description (left side of brain, e. g., in temporal region 2.0 cm. thick as against 1.0 cm. on the right).

e) Anatomical and Histological Summary

There is exudate on the base of the brain. This surrounds the vessels of the adherent pia and is made up of lymphoid cells and large phagocytic mononuclear cells and fibrin,— a similar exudate surrounds the vessels in the overlying brain tissue. The endothelial layer of the pial vessels is swollen, and in some places lifted from the underlying layer,— among many others the cells have infiltrated the muscular layers of the vessel walls. There is extreme proliferation of all forms of fibre-bearing cells, many of which have considerable protoplasm. There are foci of cell infiltration of the exudative type in the subependymal tissue where there is also much glia cell and fibre increase. The ependymal cells appear to be proliferating.

The brain of this case would have been a typical hydrocephalic brain had it not been for the complication of tuberculous meningoencephalitis. The total duration of acute disease in this case was less than four weeks, yet large collections of mononuclear cells were found in various parts of the brain, particularly in the region below the lining of the ventricles. The neuropathologist is continually astonished at the long standing look of many of these lesions despite the clinical evidence of their comparatively recent origin.

The brain photographs demonstrate more effectively than description the general anatomical situation in this case of hydrocephalus. The brain substance though in places only 3.0 mm. deep, nevertheless showed very definite stratification resembling that of the normal brain. The absolute number of cells was probably diminished and in places there was evidence of both an absolute and relative diminution in a number of cells. The acute tuberculous lesions superimposed upon the brain had given rise to various cell changes such as very general display of chromatolysis which makes it difficult or impossible to determine whether the nerve cells were to any degree hypoplastic.

Very special studies of the topography in hydrocephalus have been made by S. T. Orton in his case of hydrocephalus published in 1908. Our special interest in this study is to compare in general the findings in a case like Case XI, having a mental age of 1.2 Binet with the findings in such a case as Case XII, having a mental age of 3.4 Binet. The relations between these cases are discussed more fully in Article V.

Synopsis of Findings, Case XII.

a) Clinical.

1. Physical Examination. A.B., female, born August 25, 1895, and died April 22, 1915. Patient admitted at 9 years, 6 months, February 23, 1905. Upon admission, head was found to be abnormal, with a protrusion of forehead, abnormal width between the ears and height above the ears. Physical examination in 1914 showed height 4′ 8″, weight 99¾ pounds; good nutrition, right side of chest prominent, left sunken; thin, coarse hair; exaggeration of all reflexes, rolling of head; ankle clonus of right

side; foot-drop and wrist-drop. Scars of bridge of nose and lip; circumference of cranium 25 inches, cephalic index 84.39. Opaque left cornea; patient is blind, except that darkness can be distinguished from daylight.

2. **Family History.** Parents of old American stock, father was 29 years of age and mother was 28 when patient was born. There had been two children before patient and two later. The mother's health was good during pregnancy, but she had been subject to sorrow on account of death of patient's grandmother. It is stated that one other child is lame.

3. **Personal and Developmental History.** First peculiarity was noted in the month after birth when the abnormal size of the head began to be apparent. At about 5 years, patient began to have convulsions at intervals of a month. The convulsive tendency lasted a year; there were then no convulsions until admission of the patient.

Patient had become active and interested in things about her. Her hearing was excellent and she was passionately fond of music, playing the piano by ear. Her command of language is stated to have been perfect; gait staggering and there was echolalia.

4. **History of School Progress.** Nil.

5. **School Examinations.** Nil.

6 and 7. **Practical Knowledge and Economic Efficiency.**— Before patient became blind, she was fond of music and of playing games.

8. **Social History and Reactions.** Was fond of singing and often tried to sing in class.

9. **Moral Reactions.**— At first of rather quiet disposition, became somewhat erratic along with her mental deterioration. This deterioration was more pronounced at or about the convulsive periods.

10. **Psychological Tests.** 3.4 Binet performed June 22, 1914.

Waverley School History — After admission, patient developed convulsions at frequent intervals. She became gradually more blind and almost absolutely blind during the last year. Patient grew progressively weaker and more emaciated and after the attacks of convulsions would remain in a stupor for several days. The patient was a lover of music and played on the piano. She wound spools slowly and unevenly, was able to button and unbutton the button strips. She required aid in sewing and in weaving; was unable to darn but was able to braid. Patient tried hard to do work but it seemed that her eyesight interfered with her capacity. She was able to successfully make beds in the bed-making class and to carry out ordinary hand work.

b) Autopsy

The section was made 12 hours postmortem.

Body of a slenderly built, poorly nourished, white female 148 cm. in length.

Circumference of head, 61.5 cm.
Chin to glabella, 13 cm.
Glabella to occiput, 33 cm.
Interparietal, 25 cm.
Mastoid to mastoid, 37 cm.
Between zygomatic processes, 14 cm.
From angle of jaw to angle of jaw, 19 cm.
Ears, length, 5 cm., breadth, 3 cm.
Circumference of neck, 25 cm.
Arms, mid-biceps, 15 cm.
Wrists, 11.4 cm.
Right leg, mid-thigh, 27.5 cm.
Right mid-shin, 18.5 cm.
Right ankle, 15 cm.
Left leg, mid-thigh, 28.5 cm.
Left mid-shin, 18.6 cm.
Ankle, 15.5 cm.
Plantar surface right foot to tip of toe, 18 cm.
Plantar surface of left foot to tip of toe, 20 cm.
Circumference of thorax, 63 cm.
Circumference at crest of ilium, 63 cm.
Length of sternum, 13 cm.

Right side of chest very prominent; *left* somewhat sunken below the 8th rib.

Skin brownish in color, especially face and legs. There is a *bruise* over the left shin, 9 × 5 cm., over acromion processes, 3 × 2 cm. *Thenar eminences* are flat. *Hypothenar* eminences not developed.

There is a straight line from the wrist to the base of the little finger.

Pupils: right 0.2 cm., left not measurable.

Ventral Section.— Fat over *abdomen* 0.7 cm., over *chest* 0.5 cm., orange yellow in color. *Omentum* scanty in fat. *Stomach* 3 cm., transverse colon, 9 cm. below ensiform. *Liver* above costal margin.

No free fluid in peritoneal cavity. *Appendix* measures 10 cm., points toward liver. Spleen free. Diaphragm arches to the 5th rib on each side. Lymph nodes not enlarged.

Thorax.— Lungs overlap in median line. No free fluid in thoracic cavity.

Heart.— Weight, 198 grams. Measures 9 × 9 cm. Epicardial fat yellow and abundant. Endocardium of left ventricle markedly thickened. (This endocardium might well have been seen in a person 70 years of age.) *Heart muscle* firm, pinkish grey in color. Definite *hemorrhages* under endocardium in left ventricle.

Measurements: T. V. 9.0 cm. P. V. 5.5 cm. L. V. 1.0 cm.
M. V. 9.0 cm. A. V. 5.5 cm. R. V. 0.3 cm.

There is thickening of the free edges of the tricuspid valve and *inequality* of *aortic leaflets.* One measures 1.5 cm., the other 2 cm. in diameter at base. The coronaries show some thickening.

Organs of the Neck.— Thyroid not notable. No thymus gland seen.

Lungs.— Weight 210 grams, left. Weight of right, 269 grams. Nothing of note on section of lungs.

Abdomen.— Spleen. Weight 75 grams. Four fetal lobulations. Capsule thickened and wrinkled. Pulp firm. Trabeculae increased. No Malpighian bodies.

Adrenals.— Not notable.

Kidneys.— Weight not taken. Measure 9.5 × 4 cm. Capsule not markedly thickened. Strips easily. Cortex measures 0.4 cm. Color greyish brown. Slight injection. Apices of pyramids show white streaks. Same description for other kidney except pelvis is bathed in purulent fluid.

Liver.— Weight 875 grams. Measures 21 × 15 × 5 cm. Inferior edges blunt. Color red. Unusual amount of blood on section. No gallstones in gall bladder.

Pancreas.— Not notable.

Gastro-Intestinal Tract.— Not remarkable.

Genito-Urinary Tract.— Bladder negative. Vagina small; cervix 1 cm. in length and 1 cm. in breadth. Os extends laterally. *Ovaries* unequal in size; one measures 3 × 1.8 cm., the other 2 × 1 cm. The other ovary contains cysts.

The entire length of the uterus is 4 cm., width 2.5 cm.

Retroperitoneal Tissues. — Show no enlarged lymph nodes near the aorta. The aorta is small in calibre. Shows no sclerosis.

Head.— Hair dry; scalp thin. Inner surface of scalp shows two areas of hemorrhage 5 × 5 cm. and 2 × 3 cm. over right frontoparietal region.

Calvarium appears unequal, the right half being larger than the left. There is one Wormian bone in the lambdoidal suture on the right.

Calvarium measures 0.3 cm. in thickness.

The *dura mater* is adherent at a point near the base of the second frontal convolution on the right and over the left temporoparietal region on the left. Considerable force necessary to free it in these portions.

The brain is *remarkably dilated* in the frontal portions and in the occipital portions, a mere shell of grey matter separating the ventricles from the dura.

Over the *temporal* and *parietal regions* the substance of the brain is greater. The brain is removed without losing fluid. (It would be better to make a definite cut in the under surface of brain and remove the fluid in that way before removing brain.)

The base of the brain: The space around the optic nerves is bulging and bluish in color from its thinness and the amount of fluid which presses upon it.

The *optic nerves* are mere threads. The *olfactory bulbs,* degenerated.

The *basal vessels* show nothing especially.

The temporal tips are remarkably parchment-like and thin and the hippocampal gyrus near superior cuneiform lobe shows a triangle of whitish tissue like that described in the second right frontal. (Congenital absence of cortical material?).

The *cerebellum* and *pons* appear somewhat small but otherwise no abnormalities.

Base of skull shows flattening of the orbital plate of the frontal bone. The petrous portion of the temporal bone shows thickening but points of pressure thinning. The pituitary body is small and is encroached upon by the downward pressure of the clinoid processes.

The Gasserian ganglions were negative.

Optic nerve discs show ? of choking.

The brain and its fluid weighed 2325 *grams.* Tigges' formula 8 × 148: 1184 grams. *Gain in weight,* 1141 *grams.*

Cord negative.

Anatomical Diagnoses, General Appearance and Anomalies.

Poor nutrition.

Maldevelopment of thenar and hypothenar eminences.

Prominence of one side of the chest.

Inequality of aortic leaflets.

Infantile uterus.

Head.— Hydrocephalus with small pituitary, Wormian bones, calvarium thin and asymmetrically developed, atrophy of optic nerves and olfactory tracts, choked discs, pressure effects upon basal structures of the brain and focal adhesions of dura mater.

Acute Lesions.

Pyelonephritis.
Hemorrhagic myocarditis.
Hemorrhage of scalp.
Bruise of left shin.

Chronic Lesions.

(See also under hydrocephalus above.)

Coronary sclerosis.
Chronic fibrous endocarditis (ventricular walls and tricuspid valve).
Chronic perisplenitis.
Chronic interstitial nephritis.
Cystic ovary.
Opacity of one cornea.

c) Special Anatomical Description of Brain.

The head measurements are given in the autopsy description. The brain was markedly hydrocephalic. There were adhesions of the pia mater between the mesial surfaces about the knee of the corpus callosum. There was also a slight chronic meningitis over the base of the brain, over the orbital surfaces and about the Sylvian fissures.

The convolutional pattern is much obscured by the flattening of the hemispheres. The right hemisphere is more markedly thinned anteriorly whereas the left hemisphere is thinned out somewhat more posteriorly. The floor of the third ventricle has undergone a thinning out under pressure which has also involved the optic nerves to a remarkable degree. The optic nerves are completely flattened over the

commissure but the left nerve emerges sufficiently intact to be recognized whereas upon the right side an optic nerve can hardly be identified.

The aqueduct of Sylvius has undergone complete obliteration. The septum lucidum is made up only of a fine network of fibres. The corpus callosum itself is only very moderately thinned being as a rule less than 1 mm. thick.

The ependyma of the third ventricle is granular as also of the fourth ventricle. In the floor of the left hemisphere is a cavity formation 2 × 0.5 cm. in diameter by 1 cm. in depth. The basal vessels are small and elastic and exhibit no gross lesions.

The pia mater over the base of the cerebellum is thickened and milky. There is no asymmetry of the cerebellum which appears to show no noticeable changes in the gross.

d) Microscopic Examination.

An abstract of the most important findings yet made is as follows. The identification of areas has to be histological rather than topographical inasmuch as the hydrocephalic distension of the brain has caused wide translocation of areas reminding one of the findings in S. T. Orton's description of the pathological anatomy of a hydrocephalic brain.

Very important from the standpoint of etiology is the discovery in various areas of infiltrative cells, small and large, mononuclear cells sometimes suggesting plasma cells. This finding indicates chronic inflammation of the sort found in syphilitic disease. The findings are similar to those in Case XI. It is possible, nay probable, that both cases are syphilitic in origin—a hypothesis that may be raised for most instances of early hydrocephalus.

Cellular and fibrillar gliosis is found in the subpial layers of numerous areas. In one area (in the posterior two-thirds of the right post central gyrus) there was a focus of gliosis extending from white matter to periphery large enough to be seen in the gross. The white matter shows a general increase of neuroglia cells of a slightly irregular arrangement. The gliosis of the subpial layer is characteristically more severe at the bottoms of the sulci than upon the crowns of the gyri.

The diminution in the number of the nerve cells is less considerable than might have been expected although distinctly in evidence in a variety of loci. Very interesting is the existence of several types of gliosis ranging from fibrillar to cellular; and some of the neuroglia cells have the " active " appearance characterized by large cell bodies with distinct protoplasmic processes. Various sections taken through the ependymal layer show a characteristically marked gliosis going somewhat deeply under the layer.

The blood vessels are for the most part negative though an occasional section exhibits a focal thickening of the intima in a small vessel.

No attempt was made to make a complete histological study of this case although eighteen areas were microscopically studied and some endeavor made to count nerve cells. Occasional areas (for instance the left superior parietal) show small foci in the cortex entirely replaced by neuroglia with colloid deposits. The gliosis here was of a cellular nature showing all forms of neuroglia cells.

With respect to degenerative changes and the disposal of cell detritus there were in a few areas only a good many heavily pigmented phagocytic cells about vessels in the white matter; but other cells failed to show any pigmented phagocytes whatever.

Some areas notably the left angular gyrus (right superior frontal, etc.) show a gliosis of increasing severity as one approaches the ventricular surface — a finding consistent either with greater local pressure exerted upon the interior of the tissue or with the hypothesis of toxic effects from the ventricular fluid.

With respect to the qualities of nerve cells themselves, it was remarkable that some of the largest nerve cells retain a complete equipment of Nissl bodies but most of the large cells had a characteristically dusty appearance. Many of the nerve cells were markedly shrunken.

The tracts as seen by Weigert myelin whole brain sections show much distortion and flattening from the pressure of the hydrocephalus. The corpus striatum is flattened between the body of the dilated lateral ventricle and its equally distended inferior cornu. It gives an elongated appearance in the direction of the fibres of the internal capsule. The latter is sharply outlined and relatively less flattened than the surrounding nuclei. The external capsule and the laminae of the lenticular nucleus are also distinctly demarked. The white matter surrounding the ventricles is deeply stained, shows the fibers to be densely packed or crowded upon each other. In certain places not in direct line of pressure from the dilated ventricles, there are small areas where the white matter and cortex appear fairly normal. The optic tract is greatly reduced to about 1 × 2 mm. in cross section.

The cerebellum showed slight infiltrations of mononuclear cells in the pia mater and about the vessels and there was a slight nuclear increase in the white matter of the cerebellum. The spinal cord showed evidence of pyramidal tract degeneration more markedly upon the right side. There was also in the anterior horn regions of the spinal cord a peculiar cystic degeneration of certain cells, which degeneration seems to have destroyed the nucleus; but it is doubtful whether this change is not a post mortem one.

e) Anatomical and Histological Summary.

The brain of this hydrocephalic imbecile of twenty years weighed, with the contained fluids, 2326 grams, but no doubt far less without the fluid. The most important finding histologically is that of lymphocytosis and plasmacytosis which may be properly used to ground a hypothesis of a syphilitic origin of this case of hydrocephalus. The mechanical origin of the hydrocephalus is evidenced in the blocking by neuroglia tissue of the aqueduct of Sylvius.

Synopsis of Findings, Case XIII.

a) Clinical.

1. Physical Examination.— C. Woe. Female, born Nov. 1, 1896, died May 26, 1915. She was admitted at 8 years of age. At 17 years, patient was 4′ 6½″ tall and weighed 72½ lbs. She later increased over 12 pounds in weight. Patient was fairly developed and nourished, a mouth breather. Skin was coarse, circulation poor, heart sounds weak (systolic murmur at apex), heart enlarged. Fingers and toes were short and blunt. Circumference of cranium was 20″, cephalic index 81. Face asymmetrical, lids inflamed, nose flattened, tonsils large, tongue fissured. Wassermann test for syphilis negative.

2. Family History.— The family history of this case was worked up elaborately by Miss E. C. Macomber. Patient was the first of two children, of a father 35 years of age and mother 27 at her birth; delivery difficult, bleeding of cord for some time until tied. Patient's brother two years younger is normal. Parents: German father freed from military service on account of enlarged heart, married at 34; later had asthma and gastric ulcer; at about 30 years had epileptic seizure, two more after marriage; one just previous to birth of patient. Gouty, asthmatic, bronchitic, and died of paralytic shock; there were three shocks, the third was followed by convulsions. Was a bank auditor, of violent temper; violent headaches; two years after birth of patient remained almost blind for two years. At times sexually ascetic for long periods. Drank great quantities of liquor.

There is asthma, nervosity, paralysis, paralysis agitans and a question of insanity in the father's fraternity and the grandparental fraternity on the father's side.

Patient's mother had one convulsion during teething, was in general normal; was frightened during her pergnancy with this child by her husband coming home after an epileptic seizure; patient's mother regarded the fact that her daughter was born with swollen tongue as due to a maternal impression from

the cut and swollen tongue of her husband. Two brothers were epileptic, alcoholic and tuberculous. A sister had tuberculosis, another had ovarian tumor, a third was backward. Two brothers and one sister are described as normal. As to one sister nothing is known except that she had a miscarriage. A distant cousin had Dementia Praecox (Worcester State Hospital) and her brother was feeble-minded, probably a victim of spastic paralysis.

3. **Personal and Developmental History.**— It was noticed that patient was peculiar at two years; peculiarity was marked at 1½ years; she began to walk and talk at two and a half years; was never able to say such words as " or " or " if "; did not know the alphabet, could not read or count. She was tidy and could aid in dressing and undressing herself; could use a spoon but not a knife and fork, could not tie shoestrings. Described as sometimes obedient, liked picture books and blocks.

4. **History of School Progress.**— Nil.

5. **School examinations.**— Nil.

6 and 7. **Practical Knowledge and Economic Efficiency.**— See No. 3 above.

8. **Social History and Reactions.**— Quiet; inattentive; name had to be spoken to secure attention.

9. **Moral reactions.**— Pleasant and willing.

10. **Psychological Tests.**— 3.1 Binet performed July 13, 1914.

Waverley School History.— Training class records show incapacity at wood work and sewing. Patient was very slow at picking up papers and pins; was able at 10½ to play circle games, simple relay races, could chase the ball and catch a football, and at 12 years is described as clever at playing games. She had by this time learned to tie a knot in thread, to sew without help, and to use scissors well. Yearly records are available from 1905–1909 and a slow but definite improvement is to be noted therein. Patient changed under training from a repulsive, drooling, finger-sucking, untidy, stupid patient, taking short choppy steps and unable to jump more than 1½ feet and to make other simple manoeuvres in games (June 1906) to a tidy patient who had completed the first course of training and had begun to take part in manual training. The patient was subject to frequent colds, sore throat and stomatitis; her circulation was poor, she was subject to infections of various kinds; she had bronchitis and mumps. She was admitted to the hospital April 23, 1915, with severe bronchitis and pleurisy with friction rub; the fever disappeared from time to time. There remained marked dullness at left base; there was foetid odor and patient died May 26, 1915.

b) Autopsy.

Body of a slender, fairly nourished white female, 139 cm. in length. *Skin* rosy white except for freckles over arms and hands and liberally over face.

Scars.— Right upper arm 10 cm. from acromion, measures 4.0 cm. in diameter. *Left lower leg,* 9 cm. below patella two scars 1.0 × 2.0 cm. in diameter.

Post mortem lividity in dependent portions.

Skin slightly scaling below breasts and below costal margins. *Breasts* measure 5 × 7 cm., no pigmented areoli but outline of non-pigmented area 2.5 × 2 cm. surmounted by nipple, which is 0.6 × 0.7 cm. Breasts are placed high on thoracic wall 3 cm. below clavicle and above the fourth rib. *Left thorax* bulges slightly.

Mons is plump. *Hair* scant, represented by few scattering long hairs. *Genital cleft* long, begins 5 cm. below top of symphysis and measures 7 cm. in length × 1.4 cm. in width. *Labia majora* somewhat edematous. Hood of clitoris redundant, measures 1.4 × 0.9 × 1.0 cm. *Labia minora* are prominent, size unequal; left measures 0.4 × 2.0 cm., right 0.4 × 3.0 cm.

Pupils. — Right and left 0.5 cm. Palpebral fissure 2.4 cm. on each side; seems insufficient for eyeballs.

Face somewhat asymmetrical; right side below cheek-bone somewhat flattened. Nose shows cracking at bases of alae. Lower lip cracked.

Teeth unequal; some broad, some narrow, and not evenly placed. Marked retraction of gums of lower jaw.

On left of tongue near tip is an island of tongue tissue which is separated from the remainder of the tongue — is sessile in character, superimposed on surface and measures 1.0 × 1.5 cm. Palatine arch fairly broad.

No lymph nodes palpable; no edema.

Superficial decubitus over sacrum, measures 1 × 3 cm. Multiple *abrasions* right trochanter major. Over elbows there is a greyish brown, raised, granular appearance on the folds of the skin for an area of 2.0 × 3 cm.

Umbilicus appears protuberant.

Ventral Section.— Fat over abdomen 0.7 cm., over thorax 0.5 cm. Muscles red. Sternal length 14.0 cm., ensiform bifid. Costal arch broad. Lower border of liver 8.0 cm., stomach 11.0 cm., transverse colon 21.0 cm., below ensiform. Omentum large, scant in fat. *Intestines* white. *Appendix* points across the top of the true pelvis, is bound down by adhesions, has a mesentary to tip, measures 9 cm.

There is free fluid in the pelvic cavity, estimated amount 40 cc. Bladder contracted. Uterus drawn to right. Ovaries fairly normal in size. Mesenteric, bronchial, and retroperitoneal lymph nodes markedly enlarged, measuring in the mesentery 3.0 × 1.0 cm.; in the retroperitoneal, 3.0 × 1.0 × 1.0 cm.; in the bronchial, 2.0 × 3.0 × 2.0 cm.

Diaphragm arches to the fourth rib on the right, fifth on the left.

Thorax.— *Anterior mediastinum* shows thickening of its tissues. Mammary vessels stand open on section. *Sternal marrow* is scant, is brownish-pink in color, and appears paler than is usual. *Right pleuric cavity* contains fluid up to mid-axillary line. It is turbid and yellowish in color. *Left pleuric cavity* obliterated by firm adhesions down to the axillary line, release of which reveals yellow turbid material which is blood stained. *Pericardial sac* distended, contains excess of clear fluid. *Surface* of heart is granular and white over the inferior surfaces and on its lateral borders. There is a thymus gland which is embedded in the fat and surrounded by lymph glands.

Heart.— Weight estimated, 175 grams. Apex shows a transverse fissure between the left and right ventricles. Coronary vessels not remarkable. Right auricle dilated with clot.

Measurements: T. V. 9.0 cm. P. V. 6.0 cm. L.V. 0.8 cm.
M. V. 8.0 cm. A. V. 6.0 cm. R. V. 0.3 cm.

At the *apex* of the *right ventricle* there is a collection of purulent white material which is the centre of a firm red-white body which is adherent to and between the papillary muscles, and which covers the apex of the right ventricle. Valve not remarkable. Myocardium not friable. Section shows nothing of note. *Myocardium* slightly grey at the bases of the ventricles.

Lungs.— Weight: right, 680 grams; left, 705 grams. The *right lung* shows a granular, even increase of fibrous tissue over surface with multiple nodules yellow in color on the surface. On section, lung is greyish and greenish and dotted over with focal and conglomerate tubercles. Foul odor on section of lower portion.

Left lung, same description for outer surface except at a point near the diaphragm on the superior surface. There is a *rupture* in the pleuric wall which leads to a necrotic cavity that is foul smelling, separated from the rest of the lung by a broad band of fibro-gelatinous tissue. The *cavity* extends throughout the lower lobe. The *apex* shows peribronchial caseous areas. Peribronchial lymph nodes enlarged as before mentioned.

Organs of the Neck.— Thyroid only removed. Weight 28 grams approximately. Shows nothing of note. Thymus gland as before mentioned.

Abdomen.— Spleen: Weight, 195 grams; measures 13 × 9 × 3 cm. Capsule not thickened. Color brilliantly red; increased number of Malpighian bodies on section. Marked congestion in layers near surfaces. No increase of trabeculae.

Adrenals.— Measure 4.0 × 1.5 a 0.4 cm. Cortices are small and the central portion is unevenly brown.

Kidneys.— Combined weight, 650 grams. Perirenal fat stringy and scant. Capsule strips with ease; is not thickened. Cortex measures 0.5 cm., swells over capsule on section, is grey, not well differentiated from pyramids, which are themselves liberally streaked with white. Same description for other kidney.

Liver.— Weight, 1415 grams. Measures 21 × 17 × 7 cm. Superior surface shows thickening of capsule. There is a tracery of thickening over the entire surface. Color reddish yellow. Section shows marked increase of interlobular substance. *Gall-bladder* small, contains no stones. Content of *bladder* granular yellow fluid.

Pancreas.— Negative.

Gastro-Intestinal Tract.—Negative on sections examined except submucous hemorrhages near fundus of stomach.

Genito-Urinary Tract.— Bladder small, contracted; measures 7 × 4 × 2 cm. Inner wall somewhat pink. Vagina measures 1.8 cm. in diameter. Cervix and lower uterine segment indistinguishable. Os is a transverse slit. Uterus measures 5 cm. in entire length × 1.5 cm. in breadth at cervical end and 3 cm. in breadth at fundus. Interior of uterus and lower uterine segment negative. Ovaries appear to be distinctly fibrous in internal structure — question of small cysts.

Retroperitoneal Tissues.— Retroperitoneal glands either side of aorta numerous and red. Aorta 2.0 cm. in circumference. There are small, raised plaques of thickening in posterior walls. Sympathetic and peripheral nerves negative in appearance.

Head.— *Circumference of head* at frontal eminence, 50 cm., mento-bregmatic, 9.5 cm., and mento-occipital, 36 cm. Mastoid to mastoid, 33 cm. (anterior measurement), interparietal, 20 cm.

Hair, auburn, abundant. *Bruises* in scalp and periosteum over vertex.

Calvarium measures 0.4 cm. frontal, 0.3 cm. temporal, 0.4 cm. occipital.

Sutures and fontanelle show thinning, and there are irregularities in the thickness of the calvarium.

Grooving for middle meningeal arteries shallow. Dura thickened especially along the longitudinal sinus and in the distribution of the middle meningeal artery. Longitudinal sinus contains post mortem clot. There is scarcely any fluid beneath the pia mater, which itself is thin and delicate. Artefacts are produced in the second left temporal, in the inferior parietal region, and slightly in the second and first temporal on the right.

The dura is markedly adherent along the left side of the longitudinal fissue where the Pacchionian granulations are thickest.

Greatest length of the brain on left, 17 cm.; on right, 16 cm.

Greatest width of brain, 14 cm.

The pial veins are markedly injected and full, especially on the left. The largest vein over the vertex is anterior to the fissure of Rolando. Veins on the right are apparently equal in size.

The *frontal convolutions* are unequal, the left being smaller than the right. The *motor convolutions* are exceedingly unequal, the right precentral measuring 0.5 cm. in width, the left measuring 0.9 cm. The right postcentral, markedly prominent, measures 3 × 1.5 cm.; the left measures 2 × 1.5 cm. The *parietal regions* are markedly unequal, the right being more prominent. The *occipital lobes* are markedly unequal, the left being more complex than the right. *First temporal* on the left is smaller than the right.

At the Base.— The olfactory bulbs are adherent to the skull. The optics are somewhat edematous in appearance.

Vessels.— The vertebrals are apparently of equal size. Basilar is small, the branches normal and equal. Marked depressions in the orbital surface of the frontal poles.

Brain Weight, 1160 grams. Tigges' formula, 8 × 139: 1112 grams. Gain of 48 grams.

Base of Skull.— Posterior clinoid processes are perpendicular to the foramen magnum, and the middle clinoid processes are apparently obliterated. The *pituitary body* is tipped backward and nearly covered by an overhanging projection of the sphenoid in the mid portion of the anterior sellar curve. The pituitary body is broader than it is long. The gland portion appears fibrotic.

Gasserian ganglions and middle ears are negative.

Cord negative except in the lower thoracic segments where there is a bulging and softening. Cross section shows marked change in grey matter of a hemorrhagic nature.

General Appearance and Anomalies.

Slenderly built
Scars on extremities.
Thorax bulges one side.
Asymmetry face.
Short palpable fissures.
High placing of breasts.
Long genital cleft.
Prominence of clitoris.
Inequality of labia.
Persistence of thymus gland.
Abnormal mobility of sterno-clavicular junction.
Island of tongue tissue.
Non-development of generative organs.

Ductless Gland Changes.

Pituitary fibrotic (?).
Thyroid gland small.
Thymus gland persistent.
Marked enlargement of lymph nodes (bronchial, mesenteric, retroperitoneal).
Microadrenia.
Ovaries fibrotic.

Acute Lesions.

Tuberculous bronchopneumonia.
Pulmonary gangrene.
Hydrothorax.
Acute fibro-pericarditis.
Purulent thrombosis, right ventricle.
Acute parenchymatous nephritis.

Chronic Lesions.

Sclerosis of aorta.
Chronic fibrous endocarditis, ventricular.
Chronic interstitial hepatitis.

c) and d) Special Anatomical Description of Brain and Microscopic Examination.

The brain seems actually heavier than the body length of this Mongolian imbecile would suggest. But this disparity is perhaps due to a disproportionate shortness of the body of the subject rather than to any disproportionately large size of the brain.

There are certain inequalities in the gyri, the left frontal, left precentral and right postcentral being smaller than their fellows. The right parietal region was more prominent than the left and the sulcation of the left occipital region was more complex than the right.

Microscopically there was a moderate increase in neuroglia fibres throughout the subpial areas wher-

ever examined, but there was, on the whole, very little increase of neuroglia cells either of a general distribution or of a perivascular or pericellular distribution. There were rod cells frequently to be seen and many small pyknotic nuclei of cells with short protoplasmic processes in the white matter. Very rarely occurred slight thinness of vessel walls. There was nowhere in the numerous sections studied any evidence of exudative cells.

There was everywhere an apparent thinning out of the nerve cells varying somewhat in degree with location. When the two postcentral gyri were compared (the left measuring far less than the right) it was found that the nerve cells were far less frequent in the postcentral gyri on the left (or narrow) side than on the right. But this comparative situation cannot be said to be sufficiently marked to warrant generalization.

On the whole the main effects in this Mongolian brain appeared to be a moderate subpial gliosis and a moderately extensive somewhat locally variable diminishing in the number of nerve cells.

e) Anatomical and Histological Summary.

The brain of this Mongolian imbecile weighed 1160 grams, an apparent excess in weight as compared with the body length. The patient had lived eighteen years, dying at last of pulmonary tuberculosis with gangrene but before any marked deterioration characteristic of the Mongolian imbecile had begun to set in. The absence of evidence of chronic exudate in this brain, as so far examined, is of interest. From the standpoint of the endocrine possibilities in Mongolian imbecility it may be noted that there was a persistent thymus, that the pituitary had undergone chronic changes, that the thyroid and adrenal glands were small and that there was a marked enlargement of various lymphnodes.

Synopsis of Findings, Case XIV.

a) Clinical.

1. Physical Examination.— C. Wel. Male, born August 5, 1882, and died June 6, 1915; patient admitted at 16 years, 2 months, Oct. 29, 1898, as a custodial case.

Left testis undescended, abdomen prominent; cranium and face asymmetrical, left ear deformed; circumference of cranium at 31, 21½ inches, cephalic index 76. At 31 height 5′ 3″ and weight 142 pounds.

2. Family History.— Patient one of 12 children and at time of patient's admission at 14, 3 children had died of tuberculosis, meningitis and diphtheria respectively. The father, intemperate, 50 years of age, and mother 31 when patient was born; pregnancy normal.

3. Personal and Developmental History.— Patient began to walk at 2 years of age; first peculiarity was stated to have been noted at 6 after an attack of scarlet fever when patient became unable to talk for a time.

4. History of School Progress.— Nil.

5. School Examinations.— Nil.

6 and 7. Practical Knowledge and Economic Efficiency.— Patient took part in outdoor working classes at the school, learned to pick and handle stone and to use grub hoe and shovel, and in school house polished floors and helped with cleaning. Patient very slow and deliberate in his movements, never able to do work requiring thought.

8. Social History.— Easily managed.

9. Moral Reactions.— Quiet; no masturbation.

10. Psychological Tests.— 1.3 Binet performed Sept. 26, 1914, the year of his death.

Waverley School History.— Patient was never strong but had no severe illnesses except the last one. Ulcerative skin lesion with surrounding areas of pigmentation appeared in the winter of 1914–15. These were cleared up by sulpho-naphthol, iodides and arsenic; there was simultaneously a keratitis, it was resolved into an ulcer of the cornea of the right eye; the left eye was also affected. A cough developed, with loss of appetite, weight and strength. The lungs proved to be tuberculous and there was enlargement of the cervical lymph nodes.

b) Autopsy.

Body of a slenderly built, poorly nourished white male, 159 cm. in length. *Skin* greyish in color; is the seat of innumerable small brownish areas, in the centre of which are for the most part punctate, depressed, tissue-paper-like scars which are thickly set over thorax between the nipples and over the abdomen, and increasing in size and in number over the lower extremities; beginning at the knees, the diameter varies from 0.9 cm. to 2 cm. On *left leg*, anterior surface, there appear scars and scabs measuring 2 × 2 to 0.8 × 1 cm. On back, the appearance duplicates that on thorax.

One large lymph node superior and posterior to the sterno-clido-mastoid muscles measure 5 × 3 cm. No other palpable lymph nodes in body. No edema nor decubitus.

Pupils.— Right 0.4 cm., cornea the seat of ulcer which clouds it. Left pupil measures 0.5 cm.

Teeth.— Few missing. Gums opaque.

Ears.— Left pinna different from right, flattened out in lower half. Small abrasion in the midst of flattened portion. Abrasion of pinna of right ear.

Ventral Section.— Fat over abdomen 1.0 cm.; fat over chest 0.3 cm. *Muscles* fairly deep red in color. *Peritoneum* somewhat thickened. Lower border of liver 5 cm., of stomach 9.0 cm., transverse colon 25 cm. below ensiform. *Omentum* scant in fat. *Intestines* somewhat injected. *Appendix* retrocecal, bound down by adhesions, is coiled, measures 7 cm. *Ileum* also bound down by adhesions. Descending colon loops in pelvis. *Spleen* free except at lower border. Diaphragm arches to the fourth interspace on the right and to the fifth rib on the left. *Mesenteric lymph nodes* not enlarged. Slight slipperiness of pelvic cavity but no collectable fluid.

Thorax.— Mammary vessels stand open on section. Inner surface of sternal marrow raspberry red in color but not abundant. Slight amount of blood-stained fluid on right thorax, same on left. The lungs do not meet in median line.

Heart.— Epicardial fat present. Coronaries, descending branch of left show nothing of note. Right collapses on section; contains some red clot. Right auricle distended by red and white clot, latter portion of which is elastic.

Measurements:	T. V. 11.5 cm.	P. V. 8.0 cm.	L. V. 1.0 cm.
	M. V. 10.0 cm.	A. V. 7.0 cm.	R. V. 0.6 cm.

Myocardium greyish in color and friable. Endocardium slightly greyish. Pericardial sac contains excess of clear straw-colored fluid. Adhesions bind left lung to chest wall and are difficult to break up.

Lungs.— Weight: left lung, 1090 grams; left lung shows thickening posteriorly and is a pinkish red color. *Apex* shows nodular bodies on palpation. *Base* shows congestion. *Upper lobe* shows multiple cavities, the largest measures approximately 5 × 5 cm. Remainder studded with yellow areas 0.2 to 0.4 cm. Right lung firm; section of lung shows yellowish grey areas around bronchi.

Organs of the Neck.— Base of *tongue* covered by yellowish mucus. Foramen cecum is indicated. Mucous *glands* scattering. *Esophagus* negative. Glottis apparently somewhat wrinkled. *Vocal cords:* left false and ventricle between it and true cord covered with yellowish puriform material arranged in circular and colony form. Right one, true cord, shows an aperture at its outer third which yields brown yellow material.

Thyroid.— Negative on inspection. Parathyroid present. Lymph nodes below thyroid abundant,

but no special gland tissue seen. One lymph node measures 5 cm. in width, is yellow, and on inspection shows upper two-thirds caseous, lower third pigmented and sharply defined.

Abdomen.— Spleen: Weight, 230 grams.

Adrenals.— Large and flat. Nothing of note otherwise.

Kidneys.— Weight: right kidney, 95 grams. Capsule thickened. Kidney substance; cortex swelled over capsule, on section measures approximately 0.6 cm. Kidney measures 9.5 cm. × 4.0. cm. Pyramids well differentiated, injected at bases, streaked white at apices.

Liver.— Measures 21.0 × 18.0 × 7.0 cm. Inferior edges blunt. Capsule slightly thickened. Color bluish red. Section shows nothing of note.

Pancreas.— Negative.

Gastro-Intestinal Tract.— Negative.

Genito-Urinary Tract.— Not examined.

Retroperitoneal Tissues.— No enlargement of lymph nodes around aorta. Aorta small, no thickenings. Peripheral nerves negative.

Head.— Scalp shows growth of rather thinly placed hair. Some scars over vertex. *Scalp* adherent to the calvarium.

Calvarium: Frontal bone 0.5 cm., temporal 0.3 cm. to 0.5 cm., occipital 0.6 cm. Bone dense, no differentiation between tables. Grooving for middle meningeal arteries shallow. Some difference in thickness of calvarium noted along sutures.

Dura mater not adherent — somewhat thickened along distribution of the middle meningeal arteries and on either side of longitudinal sinus, which latter contains slight amount of greyish yellow clot.

Convolutions seen through dura mater generally, but only at focal points over frontal pole.

Pia is somewhat injected. Pia shows foci of thickenings over vertex; small collections of fluid in scattered areas.

Base of brain.— Olfactory bulbs are degenerated and adhere to skull. Optic nerves not remarkable.

Stalk of pituitary and space between it and mammillary bodies is covered by a red exudate. This involves the middle cerebrals, and third and fourth nerves. Stained specimen shows no tubercle bacilli.

Basal arteries show nothing of note except inequality of size in the posterior cerebral branches. Temporal tips firm and equally marked.

Frontal portion of *brain* shows minute and slender sulcation. Pressure ring around medulla. Fourth ventricle bound down by adhesions.

Superior surface of the brain.— Frontal portion is rounded; hemispheres appear equal but posterior two-thirds of the brain are not proportionate to anterior third. Cerebellum protrudes behind occipital tips. Occipital tips themselves appear unequal and bifid at their extremities. Parietal lobes are unequal; right smaller than left but the turnings of the convolutions more complex. Palpation shows the brain to be slightly and equally increased in consistence, especially frontally. First temporal, which disappeared on left in anterior third, is continuous on right.

At *the base of the skull* the pituitary is visible through the membrane for a space of 1.1 cm. in length by 0.5 cm. in width. Posterior clinoid processes are smooth and do not protrude. The middle clinoid is invisible; anterior clinoid small.

Pituitary shows no change.

Middle ears not notable. *Optic discs* unequal. The orbital plates show accessory sinus on the right side.

Brain weight, 1205 grams. Tigges' formula, 8 × 159; 1272 grams. Loss in weight 67 grams.

Cord not notable.

General Appearance and Anomalies.

Poorly nourished.
Abrasions and scars on body.
Corneal ulcer
Unequal pupils.
Unequal ears.
Narrow costal angle.
Unequal posterior cerebral arteries.
Fissuration simple in brain.
Occipital tips notched.
Unequal temporals.
Unequal parietals.
Unequal optic discs.
Middle clinoids missing.

Acute Lesions. None.

Chronic Lesions.

Corneal ulcer.
Fibrous pleuritis.
Pulmonary tuberculosis.
Hydropericardium.
Hydrothorax.
Tuberculosis vocal cord.
Tuberculous peribronchial lymphnode.
Enteroptosis.
Periappendicitis.
Interstitial nephritis.
Scalp adherent.
Calvarium thick.
Calvarium dense.
Dura thick.
Subpial edema.
Olfactory bulbs degenerated.
Brain weight 1205 grams.

c) and d) Special Anatomical Description of Brain and Microscopic Examination.

Noteworthy is the protrusion of the cerebellum behind the tips of the occipital lobes when the brain was observed from above. The frontal poles had a rounded off appearance and the anterior of both hemispheres struck one as disproportionately large when compared with the posterior two-thirds.

Microscopically there was found an occasional area with focal perivascular infiltration of larger and smaller mononuclear cells, the larger cells strongly suggestive of plasma cells. (Left upper post central gyrus, right post central gyrus.) But there were numerous areas in which careful examination revealed no perivascular infiltrations whatever.

The neuroglia tissue showed a moderately slight increase of cells in the outer layers of many areas though apparently quite absent in some. In some areas there was a slight general increase of neuroglia cells in the white substance whereas in other areas there was none. Satellitosis was moderately marked in various regions but entirely absent in others.

The most important finding amongst the nerve cells was their frequency in the white matter in certain areas (left upper precentral gyrus, right upper precentral gyrus, right superior temporal gyrus, right angular gyrus). This heterotopia of nerve cells no doubt argues a very early development of the condition. Some areas show an apparent scarcity of nerve cells whereas others fail to show any marked scarcity.

There is an interesting microscopic focality about the lesions in this case. The right upper post-central gyrus, for example, shows a focal enlarging of the cortex over the crowns of the gyri which is even evident in the gross. The cell scarcity here was marked and affected especially the medium sized pyramidal cells of the suprastellate layers and the internal large pyramids. A section from the right superior parietal region showed much general scarcity of nerve cells with several foci of almost complete cell destruction visible in the stained section when examined in the gross. There was here a development

of genuine encephalitic foci and underneath this gyrus there was a considerable glia cell increase in the white matter.

The tracts as studied by whole brain sections prepared by the Weigert myelin sheath method were on the whole intact. In the frontal region the gyri recti on both sides extended a considerable distance beyond the rest of the convolutions: a normal proportion exists between white and grey matter.

Through the temporal tips the ventricles were not enlarged. The two laminae of the septum lucidum are intact. The fibers of the internal capsule are well marked.

There is nothing abnormal in the general contour and relationship of the nuclei of the corpus callosum striatum.

The fibers of the corpus callosum are deeply stained. The external capsule is distinctly outlined.

In the region of the posterior commissure the white fibre tracts in general and the callosal, internal and external capsular tracts in particular are well defined. The fibers are visible surrounding the red nucleus and the locus niger.

A cross section in the region of the splenium of the corpus callosum shows nothing abnormal in the white matter.

The small vessels are seen throughout piercing the white matter in a normal way.

e) Anatomical and Histological Summary.

The occurrence of focal lymphocytotic deposits in at least two areas of the brain of this thirty-two year old patient brings up the question of its possible syphilitic origin. Possibly we should not go too far in insisting upon syphilis when a few areas of lymphocytosis are found. The fact that there were also polymorphonuclear leucocytes in one of the areas showing mononuclear infiltration was not noted above in the microscopic summary but was reserved for comment here: does this perhaps indicate that the lymphocytes in this case were part and parcel of some other process than a syphilitic one? Symptoms in this case are said to have developed after a scarlet fever at six years. The occurrence, in several areas, of nerve cells in the white matter — that is to say, a definite heterotopia of nerve cells — does not appear to suggest necessarily neurosyphilis. On the whole it would not seem wise to push the correlation of lymphocytosis with neurosyphilis too far. On the whole the brain suggests arrested development rather than a phenomenon of syphilis.

Synopsis of Findings, Case XV.

a) Clinical.

1. **Physical Examination.**— Wm. McK. male, born about 1871, was admitted at 43 years, and died less than a year later, January 20, 1915. Patient was thin and weak at entrance, showed rales in the chest, had dry skin and somewhat enlarged heart with indistinct sounds and non-transmitted systolic murmur at apex; enlarged area of liver dullness, slightly enlarged abdomen, well developed limbs; diminished patellar reflexes. Cranium circumference 21″; decayed teeth.

2. **Family History.**— Patient's sister was admitted to the School at the same time as patient; another sibling is dead; patient's aunt and children mentally deficient.

3. **Personal and Developmental History.**— The head was remarked to be small. Patient is described as lacking somewhat the sense of taste, as understanding language and commands only in part; was able to dress and undress himself with help and feed himself.

4. **History of School Progress.**— Probably none.

5. **School Examinations.**— Nil.

6 and 7. Practical Knowledge and Economic Efficiency.— Patient performed a few duties about the building, such as rubbing the floor and did small amounts of work in the dining room.

8. Social History and Reactions.— Patient willing and kind.

9. Moral Reactions.— Quiet; described as of passionate temper at times and at times disobedient.

10. Psychological Tests.— 2.4 Binet performed in 1914.

Waverley School History.— Patient's physical condition improved somewhat after arrival but in the middle of the winter, patient became less active and despite hearty appetite, gradually lost weight; later his appetite failed; there was no temperature or pain. Patient took to bed and died June 20, 1915, of abscess of the liver.

b) Autopsy.

Body of a slenderly built, fairly well nourished white male, 152 cm. in length. The *skin* is yellowish grey in color except for some excess pigmentation about the neck, which is brown in color, slightly over left cheek-bones and hands. Post mortem lividity in dependent portions. No bed sores.

There are *abrasions* over knees measuring 2 × 1 and 3 × 3 cm. Small tissue-paper scars over left lower thigh, right knee, and left shin.

Toes on left foot short; second and third held together for one third proximal distance by "webbing." The third toe on right foot is longer than the second and is curled under it. No such tendency in hands.

Penis small; prepuce redundant. Hair abundant over abdomen to above umbilicus, and grows on areoli of nipples. Apparent *accessory nipple* on right. No lymph nodes palpable. Abdomen is somewhat distended. Umbilicus shows beginning obliteration. Recti muscles feel separated.

Square, short jaw; teeth foul.

Pupils measure: right 0.3 cm., left 0.3 cm. Hairs on lower eyelid scanty, especially right, and mucoid discharge apparent. No marked asymmetry of face. Ears small but lobes not adherent.

Ventral Section.— Fat over abdomen 1 cm., over thorax, 0.4 cm. It is pale and dryish. The muscles are red but not firm. Lower border of the liver is 7 cm., transverse colon 15 cm. below ensiform. The lowest portion of the right lobe of the liver reaches to within 7 cm. of the anterior superior spine. The *intestines* are injected irregularly and markedly distended. The *spleen* is adherent and the *stomach* is dilated and pale. The *appendix* measures 8 cm. and is free. There are no mesenteric lymph nodes notable but peritoneal nodes are large, measuring 2 to 3 cm. in length, though pale in color. There is a little *free fluid* in the peritoneal cavity, especially in the pockets formed by looping of the intestines and adherence of the gall bladder. The *diaphragm* arches to the fourth interspace on the right side but is not measurable on the left. The *liver* itself is bound to the wall of the abdominal cavity by firm adhesions. The costal angle is broad.

Thorax.— The lungs are adherent to chest wall at upper portion of left and in the entirety on the right. The peritoneal sac is not tense.

Lungs.— Weights not taken. Right shows brilliant red color at base and superficial scarring at apex. The lowest portion of the lung is friable, deep red, bronchi markedly injected. The left lung shows the same change, and added to this a purulent fluid in the bronchi.

Heart.— Measurements and weight not taken. Coronaries smooth. Epicardial fat normal in amount. Myocardium red and friable. Tricuspid valve measures approximately 10 cm.; free edges somewhat thickened. Pulmonary valve measures 7.0 cm., mitral 9.0 cm., and its free edges are somewhat thickened; aortic valve, 8.0 cm., irregular thickenings of the valve leaflets. Left ventricle measures 0.8 cm., right 0.3 cm. There is no thickening of the arch of the aorta and the remainder of the aorta appears smooth.

Organs of the Neck.— Base of the tongue rough. Tonsils not removed. Epiglottis shows some tracery of injection. Rima glottis shows some general diffuse reddening. The esophageal portion of the larynx is injected, reddish blue in color, for an area extending from the base of the tongue to the upper

portion of the thyroid cartilage. The mucous membrane shows a few fine wrinkles but is not otherwise remarkable. The vocal cords appear equal and well developed. The thyroid is large, has two lobes and a well-defined isthmus, and there is nothing of note on section.

Abdomen.— Spleen measures approximately 12 × 8 × 2 cm., is soft and flabby. On section, pulp scrapes easily, is irregular in color, there being some paling of the parenchyma and some marked hemorrhages. Trabeculae markedly increased. No Malpighian bodies seen.

Adrenals.— The left is somewhat injected, but the right is brilliantly red in its entirety.

Kidneys.— The right kidney is adherent to the under surface of the liver, and upon being removed, the knife slips into a huge cavity and removes the wall of the cavity which is adherent to the capsule of the kidney. The color of the kidney is extremely yellowish pink, and the cortex measures 0.7 cm. in thickness. There is some slight tracing of red on the surface of the cortex, and there is some suggestion of paling of the apices of the pyramids; otherwise nothing of note. The intestines, pancreas, and liver were removed together, and on separating the ascending colon at a point on the under surface of the liver to which it was adherent, a large amount — approximately 500 cc.—of dirty, greenish grey, semi-fluid content escaped.

Liver.— Approximate measurements, 29 × 25 × 8 cm. The external surface uncovered by adherent diaphragm is yellowish pink in color and the inferior edge is blunt and fluctuant. On inspection of the fluctuant area, there is seen to be an irregular gangrenous change extending to the central portion of the right lobe of the liver, measuring approximately 9 × 7 cm. The inner surface of the cavity is criss-crossed by blood vessels surrounded by softened necrotic substance as noted under kidney. Smaller sections through the edge of the abscess show slight reaction to it, though there are small pus pockets in the more normal liver tissue within a limit of one centimeter from the irregular inner edge of the abscess. Direct inspection for amoebae was made but none seen. The type of cell displayed for the most part was polymorphonuclear leucocytes, with marked bubbles or droplets resembling fat, which took up a brilliant red color on exposure to Sudan III in a mixture of 70% alcohol and acetone of equal parts. Smears stained with hematoxylin (Tyzzer) especially for amoebae, show none, and no organisms are found by special stains — Ziehl-Neilson, Gram, etc.

The *gall bladder* contains 18 faceted stones; some of them are in the cystic duct. No pus nor induration around the wall. No enlarged lymph nodes.

Pancreas pale in color, not notable.

Gastro-Intestinal Tract.— Not examined in its entirety but various levels examined with negative results. There is no change in the mucous membrane except for a curious, homogeneous, black stippling of the mucous surface. (This appearance has no parallel in previous experience of examining intestines except in the lower animals.)

Genito-Urinary Tract. The bladder is small, is pointed at its fundus, and the mucous membrane is negative. Prostate not examined. Testes thread well.

Head.— Scalp thick and adherent to the bone. Junction between frontal and temporal bone marked by a ridge measuring 8 cm. Calvarium measures, frontal 0.3 cm. to 0.6 cm., temporal 0.2 to 0.5 cm., occipital 1 cm.

Dura mater adherent along centre of vertex. Depressions in inner table due to exuberant pacchionian bodies. Grooving for middle meningeal arteries uneven, being more shallow on the right side. Dura mater is thick and yellow, especially in the distribution of the middle meningeals. The frontal convolutions can be seen through it. The longitudinal sinus contains chicken fat clot, otherwise free.

Turning back the dura mater, the *pia mater* is seen to be slightly thickened along the vessels, and the vascular distribution is somewhat unequal. A large vein at the vertex on the left side shows a backward turn of approximately 1 cm., after which it goes to the extremity of the frontal pole. There is no such arrangement on the right. Small collections of fluid appear beneath the pia.

The frontal convolutions which run antero-posterior, merge into the precentral regions with no

appreciable differentiation, there being a distinct triangle formed from the third frontal and the Rolandic-mesial junction. On the right, it is even more striking, this poor marking of the regions of the brain. Excess fluid at the base of the brain.

At the *base of the brain* the olfactory tips appear slightly yellowish, tracts are thin. The optic nerves appear somewhat unequal, the right being more nearly flat. The third nerves appear intact but are slightly involved in a thickened pia, which binds them to the sides of the basilar artery. The fourth nerves are free; the fifth nerves appear somewhat bound by a thickened pia; sixth nerves the same; seventh nerves negative; eighth also negative.

The basilar artery is wide and soft, as are the other branches of the circle of Willis. Slight amounts of ante mortem clots show in the left middle cerebral.

Slight amount of pressure lipping on each lobus pyriformis. The pons is remarkably prominent and firm to the touch, as are the pyramidal tracts and olivary bodies. The fourth ventricle appears to be free from granules.

There is marked firmness of the hippocampal gyri; the occipital tips extend but slightly behind the cerebellum. The first temporal convolution is markedly narrow on the left and its posterior half almost entirely disappears. Same for right.

The *right parietal lobule* is difficult to distinguish from the occipital, and the apparent merging of frontal with precentral appears duplicated in the parieto-temporal. On the left side, the differentiation of the parietal lobule is not difficult, especially the angular.

On palpation there is a general resistance of brain tissue which corresponds with occipital tips. This is especially marked in frontal region but no normal softness obtains unless it be in the left postparietal lobule.

At the *base of the skull*, the opening for the pituitary is markedly contracted. An aperture was approximately 0.6 × 0.4 cm. surrounding the stalk. The pituitary shows small anterior lobe and large posterior lobe with apparent islands of white tissue and increase of connective tissue.

In the orbital plate on the right is a small sinus lined with purulent material, stained smear from which shows, *Gram stain*, scattered cocci, polynuclear cells, and also lymphocytes. By Ziehl-Neilson stain, no tubercle bacilli.

This sinus cavity measures approximately 0.6 × 0.4 cm. Right ear drum and mastoid cells are bathed in pus, Gram stained specimen of which shows many cocci (some in chains), and polynuclear cells. By Ziehl-Neilson stain, no tubercle bacilli seen.

Brain weight 1070 grams (3 hours later). Tigges' formula, 152 × 8 = 1216 grams. Loss of 156 grams in weight.

External Appearance and Anomalies.

Fairly nourished.
Abrasions and scars extremities.
Pigmentation neck, face and hands.
Hirsute.
Webb toes.
Genitalia small.
Redundant prepuce.
Accessory nipple.
Reversion in intestinal tract.
Calvarium thin.
Unequal grooving middle meningeals.
Frontal lobes and central convolutions anomalous.
Unequal optic nerves.
Irregular bony growth skull.

Acute Lesions.

Myocarditis.
Injection larynx.
Purulent mastoiditis.
Purulent otitis media.
Purulent blepharitis.
Purulent bronchitis.
Liver abscess.

Chronic Lesions.

Splanchnoptosis.
Perisplenitis.
Interstitial splenitis.
Perihepatitis.
Ascites.
Adhesive pleuritis.
Fibrous endocarditis.
Fatty kidneys.
Gall stones.

Dura thick.
Leptomeningitis.
Subpial edema.
Pressure pointing lobus pyriformis.
Sclerosis pons.
Gliosis hippocampal gyri.
General cerebral gliosis.
Interstitial pituitaryitis.
Brain weight, 1070 grams.

c) and d) Special Anatomical Description of Brain and Microscopic Examination.

The brain was throughout of an increased consistency. The overhang of the occipital poles over the cerebellum was very slight. There were a few inequalities of gyri (e. g. left first temporal) but on the whole the brain presents a rather normal appearance in the gross.

Microscopically there seemed throughout the sections to be a considerable evidence of edema despite the fact that the gross consistency of the brain was increased.

There was practically no increase of neuroglia cells either in the subpial regions or elsewhere except that the white matter occasionally showed a slight or moderate gliosis. This absence of any cellular gliosis seems rather inconsistent with the general permanency of the brain tissues. It is possibly due to an old fibrillar gliosis no longer associated with any increase of cell bodies but even this hypothesis has not been supported by our histological study. It is possible that this brain was cut postmortem (fifteen hours) in such a way as to show a prominence of a true edema of the brain. Edema changes as noted above were found in many nerve cells. This special neuropathological problem of the relation of gross consistency to microscopic appearances must be left unsolved.

Of more moment to the analysis of this case is the finding of a few round cells and plasma cells in the meninges in certain areas (right postcentral, right angular, left superior frontal) occasional rod cells were found in areas not always associated with the lymphocytosis. There were a few slight focal peripheral evidences of glia fibre increase. Various areas showed a marked scarcity of cells, for instance the left precentral gyrus showed very few Betz cells and some of those that remained were shrunken and some slightly swollen with eccentricity of nucleus. More definite evidence of atrophy was shown in other areas, for example the right superior parietal region showing in one area a focal enlarging of the cortex with increase of neuroglia in the outer areas over the crown of the gyrus together with some general nerve cell thinning out and a moderate focal increase of neuroglia cells in the white matter.

e) Anatomical and Histological Summary.

The brain of this low imbecile of forty-three years weighed 1070 grams but showing, no doubt, less a condition of atrophy than of aplasia. The different elements in the brain grossly taken seemed proportionate to one another. To be sure the photographs of the gross sections of the brain show posteriorly a certain diminution in the depth of the corpus callosum and the rounded callosal angles of the ventricles may well indicate a certain slight degree of hydrocephalus, presumably not due to any active dilatation of the ventricles so much as to absence of a certain amount of the investing walls.

What is the significance of the plasmacytosis in one area and the lymphocytosis in this same area and in a single other area? Shall we regard this evidence as pointing to neurosyphilis? The fact that there

was an excessive abscess of the liver in this case, say nothing of a marked purulent otitis media and mesenteritis must give us pause in any immediate tendency we might feel to charging the findings up to neurosyphilis. The situation may be neurosyphilitic or the imbecility may be due to some other form of chronic inflammation. These matters require special investigation. The provisional answer appears to us on the whole to be that the case should not be placed in the neurosyphilitic group on present evidence. Still we must feel that the diminution in nerve cells in this case is associated with rod cell increase, that is, with changes in mesenchymal tissues. Possibly these mesenchymal changes are somewhat secondary to the nerve cell changes, yet rod cells on the whole appear to have occurred in tissues subject to chronic inflammatory changes rather than in tissues subject merely to atrophy. We must leave the question in this argumentative phase.

Synopsis of Findings, Case. XVI.

a) Clinical.

1. Physical Examination.— D. E. Cur., male, born June 7, 1901; was admitted April 22, 1907, and died Sept. 16, 1915. Patient at 12 years was 3′ 10″ tall and weighed 47 pounds, was poorly developed, fairly nourished; mitral regurgitation, cyanosis feet and hands; paralysis of legs; genu internis, talipes valgus. Circumference of cranium 18″, cephalic index 76. Face asymmetrical; ears large; tonsils large; teeth good; palate high and arched.

2. Family History.— There were 4 siblings — 3 older and 1 younger than patient, one of which died of diphtheria. Other data lacking. Relatives and parents unknown. Patient a charge of Children's Institutions Department.

3. Personal and Developmental History.— First peculiarity is stated to have been noticed at 4 years, at which time patient was helpless, unable to talk, and untidy. His head was small, flat on the top and badly formed. There was no paralysis and it is stated that there have been no convulsions. Patient was slightly under-sized; hemiplegic (?). He is stated to have been very nervous, easily annoyed although not irritable; gluttonous; probably unable to recognize colors; patient was unable to grasp objects, but is stated to have been very destructive. Patient would lie in bed and make automatic movements. The cause for his deficiency is stated to have been meningitis at 6 months of age. Patient is stated to have had measles, whooping cough and erysipelas before coming to the School. Wassermann examination negative.

4, 5, 6 and 7. School Progress, School Examinations, Practical Knowledge, and Economic Efficiency.— All nil.

8. Social History and Reactions.— Good-tempered and happy but without interests.

9. Moral Reactions.— Nil. Patient occasionally had severe convulsions, becoming noisy before and after these attacks. There were some automatic movements. Six years before death patient had scarlet fever but made a good recovery.

10. Psychological Tests.— 1 year, Binet performed in 1914.

Waverley School History.— Patient died after convulsions Sept. 16, 1915.

b) Autopsy.

Body of a slenderly built, fairly nourished, white male, 128 cm. in length. *Skin* rosy grey in color. Few bruises over left leg.

Circumference of body at nipple line = 60 cm.
" " " " iliac level = 52 cm.
" " right wrist = 12.5 cm.
" " left " = 13.5 cm.

Some flattening in hypothenar eminence on right hand.

Body in right lateral decubitus.

Pupils contracted, measure 0.2 cm.

Ears somewhat outstanding, slightly unequal. Left reddened as is left side of face.

Teeth present. Good condition.

Genitalia.— Hair over pubis faint. Slight growth over mons. Prepuce long, forced back with difficulty. Considerable quantity of smegma over glans.

Left foot appears somewhat arched.

Ventral Section.— Fat over abdomen 0.4 cm., over chest 0.2 cm. Muscles red. *Peritoneum* grey and shining. *Intestines* distended, protrude over ventral section. *Omentum* scant in fat. *Transverse colon* at end of xiphoid process; lower part of liver and stomach concealed by it. *Spleen* small and free. *Appendix* lies in the pelvis, measures 12 cm. in length × 0.9 cm. in diameter. *Mesenteric lymph nodes* red, somewhat enlarged and very numerous. No free fluid in abdominal cavity. *Diaphragm* arches to 3rd rib on the right and on left.

Thorax.— Articulations between sternum and clavicle lax. Mammary vessels small. Some free fluid right pleural cavity, none in left. Lungs cover upper portion pericardial sac; thymus gland appears red and luxuriant covering pericardium to an extent of 6 × 5 × 1 cm. and extending down to cover a point overlying right auricle.

Heart.— Weight, 185 grams. Measures 8 × 7 cm. Epicardial fat scant. Descending branch left coronary negative; right negative.

Measurements: T. V. 7.0 cm. P. V. 5.0 cm. L.V. 0.6 cm.
M. V. 7.0 cm. A. V. 7.0 cm. R. V. 0.3 cm.

Aortic valve admits tip of finger. Endocardium greyish. Myocardium firm, greyish red in color.

Lungs.— Weight, 350 grams; right 410 grams. Right lung crepitant; lowest lobe blue. No scars. Bronchi bathed in red fluid. Section shows even congestion lowest lobe. Section floats. Left lung same description.

Organs of the Neck.— Tongue negative. Papillae at base of tongue prominent. Epiglottis small and prominent. Rima glottidis slender. At base of rima glottidis teat like projections curl forward and upward, giving a fish-tail appearance. Vocal cords relaxed, appear thread-like. Ventricle between true and false cords deep. Frothy mucus covers the trachea. Thyroid small. Thymus above described.

Abdomen.— Spleen. Weight 55 grams. Measures 9.5 × 6 × 2–0.4 cm. Capsule not thickened. Color reddish yellow. Section shows mottling of substance. No Malpighian bodies. No trabeculae seen.

Adrenals.— Show some central softening, otherwise not remarkable.

Kidneys.— Combined weight, 70 grams. Measurements, 9 × 4 × 2 cm., 9 × 4 × 1.5 cm. Capsule stringy, not thickened but strips with some difficulty. Cortex pinkish red, measures 0.4 cm. There are 4 pyramids. Pelvis enlarged, contains thin bloody fluid. Blood vessels negative. Other kidney contains 9 pyramids.

Liver.— Weight 565 grams. Measures 20 × 14 × 4 cm. Color reddish. Capsule somewhat thickened, inferior edge blunt. Section homogeneously red. Gall bladder contained no stones and a slight amount of thin brown fluid.

Gastro-Intestinal Tract.— Stomach injected. Duodenum negative. Colon negative.

Head.— Circumference 46 cm. Mento-occipital 40 cm. Inter-parietal 17 cm. Height of forehead frontal region 5 cm. Above left eyebrow, 1.8 cm. Above right eyebrow, 2 cm.

Brain.— 6 cm. posterior to the extreme frontal portion on the left is a depression 3 × 1 cm. Obliquely placed to the longitudinal section is a furrow 7 cm. in length running from the area represented as Broca to the point that would naturally be the precentral gyrus. The prefrontal area is indicated by the triangular area which points toward the olfactory lobes.

The *occipital lobes* are the only ones which appear to be approaching the normal in formation.

Brain substance soft. Some fluid at base.

Brain weighs 950 grams. Tigges' formula 8 × 128: 1024 grams. Loss of 74 grams in weight.

At the base of the brain the temporal tips approach leaving a space only 1 cm. in extent. The right temporal tip is broader than the left. The convolutions at the base are well marked.

Frontal poles are noticeably pointed and measure only 3 cm. in width. Gyri recti are both prominent and show a depth of measurement 1.5 cm. on the left, 1.8 cm. on the right, left being smoother.

Olfactory bulbs are edematous, optic nerves also.

Third nerves are buried in a slight thickening of pia mater.

Vertebral arteries smooth as is the basilar. No abnormalities of the formation of the circle of Willis. Pons and cerebellum soft.

Base of skull. Orbital plates of the frontal bone reach upward markedly. Middle clinoid processes are very short. Posterior clinoids broad, measure 2 cm. There is a slight bulging posteriorly of the body of the clinoid. Pituitary body measures 1.2 × 0.8 cm. Difference between lobes marked.

Gasserian ganglia small.

Middle ears negative.

Optic nerves negative.

Spinal cord soft — bulges at every cut.

General Appearance and Anomalies.

Fairly nourished.
Bruises legs.
Right lateral decubitus.
Pupils contracted.
Pubic hair scant.
Long prepuce
Appendix long.
Ears unequal.
Unequal hypothenar eminences.
Thymus persistent.
Rima glottidis malformed.
Vocal cords small.
Anomaly kidney.
Microcephalic.
Macrogyri.

Acute Lesions.

Pulmonary congestion.

Chronic Lesions.

Fibrous endocarditis.
Pulmonary congestion.
Atrophy liver.

c) Special Anatomical Description of Brain.

The photographs of this unique specimen speak for themselves with regard to the macrogyria which affects most markedly the entire superior surface of the brain and the region anterior and superior to the fissures of Sylvius upon the flanks. The observer cannot resist thinking of the resemblance of this brain to loaves of bread. The identification of sulci is a matter of some doubt. Apparently, however, the superior, middle and inferior frontal subdivisions of the frontal lobes are sufficiently well marked. Upon the left side the gyrus rectus seems unusually large and in fact the most plainly marked sulcus on the left orbital surface lies presumably far exterior to the locus of the furrow that normally demarcates the gyrus rectus.

d) Microscopic Examination.

If we examine a section from the left upper precentral region, for example, we shall find a very wide subpial layer containing many neuroglia cells with a rather dense fibrillar gliosis, but underneath the subpial zone we shall find the cortex extends nearly the entire depth of the section with hardly any signs of limitation and hardly any differentiation of the cells from one another in point of size. There are two lines of Betz cells; the one placed at some distance, the other Betz cells themselves containing little or no Nissl substance. Most of the other nerve cells in the tissues seem smaller than normal and pale without differentiation of Nissl substance. Their nuclei stained rather deeply and densely. There was a moderate increase of neuroglia and satellite cells throughout the section. Rod cells were also frequent. There was no evidence of perivascular exudate either in this section or any other section.

A section taken from the left postcentral gyrus begins to show some attempt at lamination but the lamination is still very incomplete. In this section as in a section from the posterior two thirds of the left first temporal gyrus the nerve cells are scattered without regard to form.

Passing back to the superior parietal area a fairly distinct lamination begins to be evident though still widely varying from the normal. Cortical cells are still found far down in the white matter, even the left superior parietal area shows scarcity of nerve cells and abnormal width of cortex although it yields a lamination more distinct than elsewhere.

The sections upon the right side show slightly better attempts at lamination but on the whole approximate the findings on the left side of the brain.

With respect to the cerebellum it was noteworthy that there was no suggestion of Vignal's layer nor was the cerebellum very remarkable. Purkinje cells were numerous but their nuclei stained deeply and densely much as the nerve cells in the cerebrum did.

This case deserves the most extended study. For the present purpose we report only a few of the more striking appearances in the sections already made.

In the macroscopical examination of the whole brain sections in this case, one is forcibly struck with the great thickness of the cortex throughout. The small number of convolutions and simon-simple brain pattern, which makes for a greatly contracted cortex area, seems to be compensated for in a way by this extreme thickness. This condition prevails especially over the convexities and internal surfaces, and to a lesser degree on the base of the brain where the convolutional pattern is much more complex and begins to approach the normal: the latter more normal structural picture is found especially in the regions of special sense, such as temporal, cuneate, and pyriform lobes. The cortex is also thin and more reduplicated in the gyri recti. By actual measurement the cortex in the simpler areas varies from 6 mm. to 13 mm. In the more complex areas mentioned it varies from $2\frac{1}{2}$–3–4.5 mm.

The ratio of white to grey matter is therefore not so greatly disturbed as it would seem on cursory examination; on the whole, however, the white matter suffers at the expense of the thick cortex.

Through the frontal lobes anterior to the genu of the corpus callosum, the cortex is enormously thickened, especially on the top and outer aspects. The white matter is pierced by small vessels and shows no degeneration. At the level of the genu they are dilated measuring variously from 1 mm. to 5–7 mm. In the temporal region this condition in unilateral. The fibres of the internal capsule in this region seem to be fewer than normal. There is beginning formation of the gyrus cingulus.

In the mid-callosal level the white matter is likewise proportionately reduced, which condition corresponds with the smaller and more or less ill-defined fibre bundles of the internal capsule. The perivascular spaces are also slightly dilated in the level of the splenium.

In the occipital region the appearance resembles the frontal. There is again greater preponderance of grey matter on top and laterally. Internally and at the base the cortex is thinner and here the white matter asserts itself. The ventricles appear normal in size. The ependymal lining, however, is slightly thickened generally. In the cerebellum the grey matter seems unevenly distributed on the two sides.

This striking case of macrogyria (the " loaf-of-bread " brain) presents problems of its own. The greatest problem no doubt is the cause of the failure of sulcation to develop over the whole top and fore parts of the brain, while at the same time no proper layering was going on inside the brain substance. Now this poor furrowing outside and poor layering inside go hand in hand: as one passes backward and beneath zones of more normal furrowing, one comes upon much better layering, until in the occipital poles there is, if not a normal, then a somewhat familiar looking lamination. Another pretty problem here is the relation of a fairly well developed corpus callosum to an otherwise poorly developed brain. In general, with this brain, we are evidently dealing with some mortific agent or some development-arresting agent, operating in the embryonic life and paying heed not so much to architectural details as to certain major trends on the part of the brain. Which is primary, the flaw in the furrowing process or some hypoplasia of lamination?

e) Anatomical and Histological Summary.

The brain of this fourteen year old idiot weighed but 950 grams and showed a remarkable condition of macrogyria. Without showing any evidence whatever of chronic inflammation there was nevertheless marked evidence of rod cell formation in this brain. The difficulty is clearly not hardly one of nerve cell aplasia though no doubt the bulk of the effects are due to some form of aplasia supervening in the embryonic life. The comparatively good preservation of the corpus callosum is a matter of remark.

Synopsis of Findings, Case XVII.

a) Clinical.

1. **Physical Examination.**— A. E. Ken., female, born Oct. 17, 1883, was admitted Sept. 13, 1911 and died Oct. 13, 1915. In February, 1914, patient was 5′ 1¼″ tall, weighed 118 pounds, was well developed and nourished, round-shouldered, myopic. Abdomen prominent, patellar reflexes exaggerated. Cranium circumference 21″, cephalic index 78. Slight beard, face asymmetrical, several front teeth missing, tongue fissured, high arched palate.

2. **Family History.**— Mother was 19 years of age and father 25 at birth of patient; father was killed by a fall from staging at 31. Pregnancy normal. Father's family stated to have been not brilliant but happy-go-lucky, phlegmatic and rather peculiar. Five of the mother's family, also maternal grandfather and grandmother died of tuberculosis.

3. **Personal and Developmental History.**— Patient is stated to have irregular monthly periods, to have been always slow in speech and motions and more so after twelve years of age. Patient was inclined to be gluttonous. Stated to have fallen several feet, striking on her head at the age of twelve.

4. **History of School Progress.**— At the School learned to read and write and to write her own letters, also to do simple number work.

5. **School Examinations.**— Nil.

6. **Practical Knowledge.**— Patient had lived in a family who had taken care of her although not related to her.

7. **Economic Efficiency.**— Did housework for this family. Was a laundry worker at School, although slow in movements, but very steady worker.

8. **Social History and Reactions.**— Patient got on well with other girls, made no friends, kept by herself, seemed to like to sit and watch others.

9. **Moral Reactions.**— Disposition good.

10. **Psychological Tests.**— 7. Binet performed in 1914.

Waverley School History.— Patient steadily retrograded after admission; although at first tidy in personal habits, patient at one time became untidy, later improved in this respect. Began to lose weight and strength in the last year of life; had an attack of furunculosis and 9 months before death had a severe convulsion after which she was dazed and could not walk well for some time. In February, 1915, patient had two severe convulsions, falling and bruising her forehead. After these convulsions patient was dazed for days, did not recognize people about her, talked and muttered incoherently, was untidy. In March occurred an attack of dysentery from which she recovered but kept steadily losing in weight. Patient died Oct. 13, 1915.

b) Autopsy.

Body of a well built and nourished white female, 160 cm. in length. Skin yellowish grey in color except for post mortem lividity over posterior neck regions and in dependent portions. Skin is soft and elastic. Faint yellowing of skin over forehead at hair line which follows hair line to ears.

Hair grows over forearms, slightly over breasts, abundantly over upper lip, chin and upper third of lower legs. Marked curling of hair over pubis.

No *edema.* No *decubitus.* Rigor mortis present. Umbilicus contains cerumen.

Pupils: right measures 0.6 cm., circular and regular; left measures 0.6 cm., is slightly irregular in outline.

Ventral Section.— Fat yellow and moist. Some increase of interstitial tissue; measures 3.0 cm., over abdomen: 2.5 cm. over thorax. Muscles of chest and abdominal wall red. *Peritoneum* grey. *Costal angle* broad. *Lower border of liver* 9.0 cm., *stomach* 13.0 cm., *transverse colon* 20.0 cm. below ensiform. Free edge of omentum markedly injected, otherwise scant in fat. Spleen large and free. Appendix injected at proximal portion; measures 7.0 cm. in length, also injected at tip. No free fluid in peritoneal cavity. *Mesenteric lymph nodes* prominent, somewhat enlarged, especially coecal group. *Bladder* contracted. Uterus markedly reddened on posterior surface, as is left fallopian tube. Left ovary plump, slightly more so than right. *Diaphragm* arches to the 3rd rib on the right, 4th on the left.

Thorax.— Fluid escapes on opening right thoracic cavity. This fluid is yellowish and free from blood tingeing. On opening left pleuric cavity, small amount of blood is present but is turbid and yellow. *Mammary vessels* collapse on section. Anterior mediastinum filled with fat. Lungs voluminous, almost meet in median line. *Right lung* adherent to pericardial sac at outer surface. Outside of pericardial sac congested, inside contains an excess of pale fluid. Right lung is adherent to the chest wall over the 2nd and 3rd ribs anteriorly.

Heart.— Weight, 195 grams. Measures 9 × 8 cm. Epicardial fat abundant. Descending branch of left coronary smooth; right collapses on section and walls are delicate.

Measurements: T. V. 11.0 cm. P. V. 5.0 cm. L. V. 0.8 cm.
M. V. 8.0 cm. A. V. 6.0 cm. R. V. 0.4 cm.

The free edge of the tricuspid valve is slightly thickened. Cusps of the pulmonary valve unequal in size. The *endocardium* slightly grey near valves but is not involved at apex. Superior edge of one aortic leaflet slightly puckered. Myocardium red and firm.

Lungs.— Weight, left 1075 grams, right 1035 grams. Right lung, upper lobe, soft, greyish white; middle lobe adherent to chest wall; lateral border of middle and posterior border of lowest deep red. Section shows mottled red and grey lung tissue; reddish areas surround grey ones which in turn are localized around the bronchi. An odor suggesting the breaking down of lung tissue accompanies this. Fibrin can be expressed from some of the bronchi in the middle lobe. A smear shows pus cells. No Gram + organisms. A few Gram negative bacilli. No tubercle bacilli. Bronchi bathed in blood. *Left lung*: upper lobe free; lower lobe blackish red in color superficially. Section duplicates description of other lung.

Organs of Neck.— Not removed.

Abdomen.— Spleen. Weight, 170 grams. Measures 13 × 8 × 2 cm. One fetal lobulation extends for 7.0 cm. across the superior surface. Capsule pinkish blue in color. Section shows pulp firm and red, otherwise negative. Malpighian bodies not present. Trabeculae slightly increased.

Adrenals.— Large and plump; show some central softening.

Kidneys.— Weight, 170 grams. Measure 10 × 5 × 2 cm. and 9.5 × 5.5 × 2 cm. Capsule thin, strips easily. Cortex measures 0.6 cm., is greyish with brilliant injection and granular surface. Six pyramids all deeply red. Pelvis negative. Other kidney shows same description.

Liver.— Weight, 1475 grams. Measures 25 × 18 × 6 cm. Inferior edge of liver fairly blunt. Capsule slightly thickened. Color reddish, slightly mottled by yellow. Section shows nothing of note. Gall bladder contains no stones but has slightly granular brownish fluid.

Pancreas.— Thin but shows no abnormalities on section. Splenic artery slightly thickened.

Gastro-Intestinal Tract.— Esophagus not notable. Stomach small, yellowish white in color. There are pinhead to pinpoint nodules in the mucosa of the stomach wall surrounding the esophageal opening in the stomach. *Lesser curvature* shows some submucous hemorrhages with isolated black dots (? indicating former hemorrhages). Pyloric opening small, otherwise not notable. *Duodenal content* pale with markedly granular appearance to mucosa. *Jejunum* negative. *Upper ileum* shows spots of congestion and wall somewhat thickened, especially in lower portion. About 9.0 cm. above ileocecal valve there is induration and injection of a single Peyer's patch. This has a slightly " shaven beard " appearance with the addition of punctate raised and deeply reddened surface. Immediately above the ileo-cecal valve, the Peyer's patches are markedly enlarged and reddened and here and there are beginning ulcer formation. These are minute, measuring not more than 0.2 cm., are fiery red; edges somewhat raised. *A smear* from the center of these shows by Gram disintegrated cells, Gram negative plump bacilli and Gram + cocci. By Ziehl Neilsen, no tubercle bacilli.

In the mucosa of the cecum there are clusters of raised yellow ? reddish areas which spread slightly, not unlike herpes. There are *solitary ulcers* on the summits of the rugae which are small, fiery red, as are the ones which surround the Peyer's patches in the ileum. These solitary ulcers dot the ascending and transverse colon but do not extend into the descending colon. Rectum free.

Genito-Urinary Tract.— Bladder somewhat injected. Vaginal mucosa wrinkled. Uterus shows some free blood in the interior. Ovaries show some appearance of functioning.

Retro-Peritoneal Tissues.— The aorta is smooth. Small ulcers show some faint, raised yellow plaques about the origin of branches. The lymph nodes along the aorta are somewhat redder than usual. Culture taken. Peripheral and sympathetic nerves show nothing on inspection.

Head.— *Hair* brown and abundant. *Scalp* not remarkable.

Calvarium measures frontal, 0.5 cm., temporal 0.3 cm., occipital 0.6 cm.

Dura mater not adherent, is slightly thickened over vertex and in the middle meningeal distribution.

Pia mater is thin and delicate except along the vessels over the vertex; here it is slightly cloudy. There is an abundant collection of clear fluid over the parietal and motor regions. The hemispheres appear equal.

Convolutions exceedingly complex. The tips of the occipital pole markedly smaller than normal and there appears to be an anomaly of the left parietal lobule inasmuch as it appears to encroach upon the superior portion of the occipital lobe. This is more marked on the left than on the right. The left second temporal markedly interrupted by crisscrossing of gyri running at different angles than usual.

Base of Brain.— Cranial nerves show nothing of note. Basal vessels small, somewhat white.

Slight granularity of pia mater at the base, smear from which shows red blood cells and endothelial and connective tissue cells. There is no increase of consistency palpable at base. Superior surfaces show a general increase.

The right Gasserian ganglion is edematous. Pituitary fairly well exposed. On section the pituitary appears yellow in its posterior portion (? former hemorrhage). Ear drums negative.

Brain weight, 1375 grams. Tigges' formula 8 × 160: 1280 grams. Gain of 95 grams.

General Appearance and Anomalies.

Well nourished.
Pupils dilated, one irregular.
Anomalies: aortic leaflet.
parietals.
occipitals.
Gasserian ganglia.

Acute Lesions.

Bronchopneumonia.
Hemorrhagic bronchitis.
Cardiac dilatation.
Ulcerative ileitis and colitis.
Endometritis.
Parenchymatous nephritis.
Hemorrhagic pituitary.
Lymph loops in gastric mucosa.

Chronic Lesions.

Hydrothorax.
Fibrous pericarditis.
Hydropericardium.
Fibrous endocarditis ventricular.
Splanchnoptosis.
Atrophy spleen.
Dura thick.
Leptomeningitis.
Subpial edema.
Brain wt. 1375.

c) Special Anatomical Description of Brain.

The complexity of the convolutional pattern is noteworthy in this brain. The tips of the occipital poles appear to be smaller than normal and there is also an anomaly in the appearance of the parietal areas. The pia-arachnoid was everywhere slightly cloudy and somewhat more adherent to the dura mater along the longitudinal fissure than is usual. There were also pial adhesions to the frontal lobes. There was a very fine granulation in the floor of the third ventricle and a suggestion of this in the fourth.

The summits of the gyri failed to lie always in the same plane and their borders were not always approximated. The tendency throughout this brain is to a point rather than to a flat tipping of the gyri and this acuminate tendency is especially well shown in the frontal and prefrontal areas. There was a slight thinning of the posterior third of the corpus callosum.

d) Microscopic Examination.

No perivascular exudate was to be found in most areas, yet about a single vessel in the left angular gyrus there was a focus of small round cells of the exudative group and in the left superior frontal gyrus there were focal groups of small round cells of the lymphatic group. There were nowhere any plasma cells.

The blood vessels were not anywhere remarkable.

There were moderately slight increases of neuroglia cells in the outer layers in many areas, some-

times this glia cell increase was more focal than general. The white matter also showed a slight or moderately general glia cell increase.

The nerve cells showed some acute changes (axon reactions and simple chromatolysis). Many areas showed no thinning out of the nerve cells but other areas showed focal thinnings out of cells well distributed through the cortex. In some areas (e. g. left superior temporal) the falling out of cells was more marked in the supragranular layers. In some places the thinning of the cells was more marked over the crowns of the gyri than upon their sides (left angular gyrus). There were in many areas increases in numbers of the satellite cells about the nerve cells.

The general relationship between the white and grey matter appears normal. There are no gross fiber tract degenerations; the white matter throughout firmly takes the Weigert stain. There are no gross morphological changes. The ventricles are not dilated. The occipito-frontal fascicle is shown in faint outline and the subependymal grey matter is plainly visible. The internal capsule is well defined as is also the external capsule. The optic tracts are sharply outlined. The external and internal lamina of the lenticular nucleus are distinct. The ependyma is slightly thickened posteriorly.

The cerebellum showed in some areas a noticeable scarcity of Purkinje cells. In other areas there appeared to be a normal quantity of Purkinje cells but their arrangement was scattered.

e) Anatomical and Histological Summary.

The brain of this thirty-one year old imbecile was of good weight (1275 grams). On the whole, although there are a few evidences of chronic imflammation in this brain the rest of the histological picture seems to bear slight relation to the lymphocytosis (no evidence of plasmocytosis). The situation appears to be one of a somewhat irregular though general tendency to aplasia of the gyri in the manner termed " pointing." There was no evidence of nerve cells in the white substance nor any special tendency to heterotopia of cells except in some parts of the cerebellum.

Synopsis of Findings, Case XVIII.

a) Clinical.

1. Physical Examination.— D. Ric., male, born May 2, 1906, admitted Jan. 18, 1912 and died Nov. 9, 1915. July 28, 1913, patient at 7 years was 3′ 9″ tall and weighed 43¼ lbs.; was poorly developed and nourished, had chronic bronchitis, had dry coarse skin, thin, coarse, wiry hair and heart with systolic murmur at apex; infantile genitalia; umbilical hernia; protruding abdomen; poorly developed muscles; thick hands, short, stubby fingers; cranium circumference 23″, cephalic index 80.77; bulging forehead; asymmetrical face, large protruding ears; chronic discharge of nose; tonsils enlarged, adenoids; fissured tongue. It was a question whether patient was a cretinoid idiot.

2. Family History.— There were six children of which patient was the second. The first three children resembled each other somewhat closely and all died at the Massachusetts School for Feebleminded. Three later children were normal, one dying young of diphtheria. The mother is said to have been emotionally disturbed during pregnancy; patient's father was 26 years of age at patient's birth. A paternal aunt became blind in later years; an uncle and sister of the patient had spinal trouble; the sister in question became partially blind; there was a feeble-minded and epileptic great-aunt.

A special study of the heredity was made by Miss E. C. Macomber. It is stated that abortions were attempted with drugs in the early months of pregnancy in each of the three feebleminded; the three children lived as follows: first 1905–1912; second (patient) 1906–1915; third, 1907–1912. The

sister born three years later is not feeble-minded and a child born years after this sister, prematurely, died at one year old. Two children followed: the three living children are said to be normal. The mother has two competent sisters, a sister migrainous and obese whose one living child has one arm not fully developed. Five other siblings of patient's mother died young. Both patient's mother and maternal grandmother are stated to have been nervous, and patient's grandmother also migrainous.

The siblings on the father's side are apparently normal, middle-class persons, except one who was alcoholic and tuberculous and another was deformed, with spinal curvature. There is an epileptic and feeble-minded great-aunt, a lame great-uncle and a blind great-aunt.

3. Personal and Developmental History.— Patient began to talk at about a year and to walk alone at 19 months. Peculiarities were first noted on 2 years. Patient had peculiarity in speech, using " D " for the first letter. Was able to help in dressing and undressing himself and to feed himself with a spoon or fork.

4, 5, 6, 7, and 8. School Progress, School Examination, Practical Knowledge, and Economic Efficiency.— All nil.

8. Social History and Reactions.— Patient was stubborn, irritable, running about in his own way, screaming when touched to be dressed or undressed, spitting on the floor and screaming if he did not wish to be moved; would not eat if any one was looking at him; had lost capacity to feed himself, throwing food about. Patient loved dress and was fond of pretty neckties. If given a toy would go by himself to play with it, screaming if another child went near him. If candy was being distributed, patient would join the crowd of boys surrounding the donor and stretch his hands up for some. Patient said " No " to almost everyone. Patient was rough with other children, throwing anything he had in his hands. He would smile at people he liked but was not affectionate and did not wish to be petted. He recognized the people who took care of him and was not shy with them.

9. Moral reactions.— (See social reactions). Patient would cry a good deal and pounded his head on the back of settees; he had a habit of putting his hands over his face and peeking through his fingers as if bashful.

10. Psychological Test.— 1.0 Binet performed May 11, 1914.

Waverley School History.— Patient required nursery care; was in the hospital and infirmary most of the time, with habits untidy day and night. Patient had frequent illnesses, chicken pox, measles, bronchitis, indigestion, grew thin and developed a cough, Nov. 4, 1915; had slight unilateral convulsion with twitching of right side of face; spasmodic opening and shutting of mouth; there was for a time severe dyspnoea with mucus in throat and weak pulse; after vomiting patient seemed slightly relieved. Patient gave an impression of meningitis, remained comatose; Nov. 5th had developed bedsores on back of his head and on hip; and could at this time swallow with difficulty. Nov. 8th was unconscious with slight paralysis of right side of face; right eye open with sloughing of right cornea; death Nov. 9, 1915.

b) Autopsy.

Body of a slenderly built, poorly nourished white male, 115 cm. in length, in left lateral decubitus, four hours post mortem. Skin rosy grey in color. Small *decubitus* over left trochanter major measures 2 × 2 cm. in diameter. Slight bluish *discoloration* over right trochanter. Abrasions over tip of the nose and lower lip measure 1.1 and 1.2 cm. Two abrasions on knees co-incident at point of pressure.

Hair shows faint growth over abdomen and chest, over forearms and upper arms; none over pubis, abundant over neck and back; growth in multiple cowlic over head. Suggestion of bowing of right radius in lower third; same on left. No roughening of tibia.

No palpable lymph nodes except left inguinal region.

Penis small. Prepuce redundant. Testes descended. No edema.

Flattening of thenar and hyperthenar eminences. Right hand measures 6.5 cm. over knuckles; left same. Greatest length, 13.0 cm. Snuff box deep.

Pupils — right 0.6 cm., left 0.4 cm. Suggestion of bruising of right eyelid. Eyeballs firm. Conjunctiva over right cornea denuded (2 days in duration).

Hair rough and short but fairly abundant. Two abraded areas on occipital portion measure 2 and 1 cm. in diameter. Circumference of head 58.8 cm., mento-occipital 47 cm., mento-bragmatic 10 cm., mastoid to mastoid 38 cm.

Nose short and broad (saddle).

Teeth — two middle incisors upper, highly placed, not in line with the first teeth. Four central incisors in lower jaw.

Ears somewhat thick through, lobules not adherent, measure 6 cm. and 5.5 cm. in length.

Circumference of chest at costal margin 53.0 cm.

Rigor mortis present.

Ventral Section.— Fat over chest and abdomen scant. *Muscles* yellowish red. *Peritoneum* grey. *Costal angle* medium. *Lower border of liver* 6.0 cm., *transverse colon* 15.0 cm. below ensiform. *Omentum* scant. *Transverse colon* in "S" shaped arrangement covers stomach. *Spleen* — small adhesions external surface. *Appendix* coiled upon itself. *Mesentery* to tip, measures 10.0 cm. *Mesenteric lymph nodes* prominent, numerous, and vary from 0.5 to 1.5 × 1.5 cm. No free blood in peritoneal cavity. *Diaphragm* arches to the 3rd rib on right and 3d rib on left.

Thorax.— Pleura free from fluid and adhesions. Lungs meet in upper third of their free edges. *Pericardial sac* red. No excess of fluid; that which is present is clear yellow in color. (Phenomenon of post mortem auricular contraction present 4 hrs. P. M.) after removal of brain.

Heart.— Weight, 85 grams. Pericardium smooth and shining. Appendage free from clot; wall 0.3 cm. Muscle pale. Right auricular endocardium smooth and shining.

Measurements: T. V. 8.0 cm. P. V. 4.2 cm. L. V. 2.0 cm.
M. V. 6.5 cm. A. V. 4.0 cm. R. V. 0.4 cm.

Tricuspid valve cusps markedly thickened, irregular and saw-toothed, without marked calcification; admits little finger. Right ventricle muscle pale. Chordae tendinae and papillary muscles appear normal. Pulmonary valve cusps not thickened, appear normal. Pulmonary artery shows no pathological change. Left auricle — wall 2.0 cm. *Endocardium* smooth and shining. Ventricular cavity appears slightly enlarged. Mitral valve opening about 2.0 cm. in diameter. Valve cusps are greatly thickened, contracted but not markedly calcified. Chordae tendinae appear normal. Papillary muscles hypertrophied. Left ventricle is of good color. Valve cusps slightly thickened and stiff, otherwise not remarkable. Ascending portion of aorta smooth without pathological change. Coronaries appear normal.

Lungs.— Weight, right lung, 110 grams; left lung 95 grams. Visceral pleura smooth and shining. Bronchus and bronchioles show no pathological change. No pus. Slight amount of hypostatic congestion lower lobe. On cut section surface appears rather dry. No pus is exuded on pressure. No tubercles seen at any point.

Abdomen.— Spleen. Weight, 85 grams. Measures 10 × 6 × 2.5 cm. Dark bluish purple in color. Cut section is dark mahogany red in color. Pulp not increased. Slight amount of bloody fluid easily scraped off. Normal anatomical markings clearly seen. Small accessory spleen size of a pea on left, above.

Adrenals.— Show nothing of note.

Kidneys.— Weight, 85 grams. Normal in size and shape. Capsule strips easily. Kidney cuts with normal resistance. Cortex measures 0.5 cm. Pyramids pinkish in color, surrounded by dark rim.

Liver.— Weight, 680 grams. Color brownish, slightly mottled. Edges sharp. Capsule smooth, not thickened; everywhere normal in consistency. Cut section surface seems rather dry but otherwise

not remarkable. Gall bladder normal in size and position, walls not thickened and contains about 26 cc. of bile; normal in appearance.

Pancreas.— Shows nothing of note.

Gastro-Intestinal Tract.— Stomach small and contracted. Rugae present. Some bile stained material on wall. Nothing of note in tract. Excess of rectal length, 18.0 cm.

Genito-Urinary Tract.— Bladder small, prostate thin — (kept unopened for research for Dr. Rohde).

Retroperitoneal Tissues.— No change noted in sympathetic and peripheral nerves. Retroperitoneal lymph nodes somewhat enlarged, as are mesenteric, but not as numerous as the latter. Aorta elastic, smooth except for few dots of thickening near origin of vessels.

Head.— Calvarium measures 1.0 cm. median line, 0.5 cm. either side, temporal 1–0.7 cm., occipital 1.0 cm. Under surface of scalp shows bruise in vertex and over right frontal region; these measure 4 × 3 cm., 2 × 1.5 cm. and 5 × 2.5 cm. Periosteum negative. Temporal muscles poorly developed. Sutures prominent.

Superior Surface of the Brain.— Dura adherent to the calvarium in its entirety.

Pia mater cloudy over all portions except occipital and portions of the parietal lobes. Left side is more densely covered by thickened pia and ? new formation of membrane than the right.

Convolutional pattern is fairly rich. Rosette formations are frequent. Atrophy and gliosis everywhere present. This atrophy also apparent in the mesial portion. Slight indication of softening in the angular gyrus region. Some subpial hemorrhages over supramarginal region on the left.

Base of Brain.— Left hemisphere sags more than right and the base shows a marked asymmetry and irregularity. The left temporal lobe is markedly atrophic but contains more complex windings of gyri than the right. Left hemisphere measures approximately 18.0 cm., right 19.0+ cm. This shortening appears to be in the frontal pole, greatest distance from Sylvian fissure to the prefrontal pole on left being 4.5 cm., on right 6.0 cm. At the base of the olfactory bulbs the grey matter presents a hump measuring 3 × 1.5 cm. on the right, 4.4 × 1.5 cm. on the left median line.

In the orbital portion of the frontal pole there is marked depression on the left side, which is not so marked on the right. The first temporal convolutions measure 0.7 cm. on the right; appears to be hidden on the left. Convolutions at the tip measure 0.8 cm. on the right and 1.3 cm. on the left. Marked irregularities and atrophies on both temporal lobes. Lobus pyriformis prominent on the left, has a pyramidal appearance; right is circular; both firm, right more so than left. Entire base markedly firmer than normal.

Olfactory tract thin. Optic nerves small.

Circle of Willis is obscured by thickened pia mater. There appears to be no anomaly. The vertebrals are markedly irregular and unequal in size: left measures 1.0 mm. in width.

Fourth ventricle — granulations are present and ependyma appears gelatinous.

Mammillary bodies appear oval.

Pons medulla and cerebellum present nothing of note except rather firmer than normal.

Smear from base of brain by Ziehl-Neilsen stain shows no tubercle bacilli: by cresyl-violet shows an occasional polynuclear cell, otherwise cells are of uneven size of endothelial type.

Base of Skull.— The cribriform plate of the ethmoid is sunken to a depth of 1.3 cm. and measures 2.6 cm. in length × 2.0 cm. in width. The tips of the frontal lobes fit into this depression. The anterior fossa shows marked bulging upward to the orbital plates. The posterior clinoid processes measure 2.0 cm. in width. The middle clinoid 0.8 cm. The pituitary is well uncovered. Glandular portion of the pituitary is redder than usual. Nervous portion apparently somewhat pigmented (brown).

Pus wells out of the right middle ear, stained smear from which shows fatty infiltrated leucocytes and minute Gram positive bacilli.

Brain weight, 1475 grams. Tigges' formula 8 × 115: 920 grams. Gain in weight, 555 grams.

Physical Signs of Degeneracy.	*Vierordt's Table.*	
Length of child of ten years,	127.8	115
Size of head (circumference)	52.2	58.8 cm.

Saddle nose.
Bowing of radii.
Hair stubby and " wild growth " over head.
Excess of hair over neck and back.
Ears thick.
Teeth (late eruption of second teeth — high placing).
Hands show unusual form.
Bones unequal in size and thickness, skull.
Olfactory lobes prominent — (like a dog's brain).
Malformation of skull (anterior fossa).

Evidence of Syphilis.

History significant.
Father's attitude significant.
Chronic pachymeningitis.
Chronic leptomeningitis.
Cerebral atrophy.
Cerebral gliosis.
Spinal gliosis.
Chronic endocarditis.

Against Syphilis.

Negative Wassermann reaction in serum post mortem.
Negative Gold sol reaction in all loci.
Negative plasma cells in base of brain.

General Appearance and Anomalies.

Poorly nourished.
Left lateral decubitus.
Flat thenar and hypothenar eminences.
Bruise eyelid.
Abrasions head.
Nose short and broad.
Ears thick.
Bedsore, trochanteric.
Pupils unequal.
Hair abundant over neck.
Hair grows in cowlic over head.
Head large.
Teeth uneven.
Ears unequal.
Redundant prepuce.
Penis small.
Postmorten cardiac contraction.
Accessory spleen.
Excess rectal length.
Middle fossa change.
Rosettes in brain pattern.
Unequal temporals.
Unequal vertebrals.

Acute and Chronic Lesions.

Otitis media.
Subpial hemorrhages.
Bowing radii.
Lymphnoditis mesenteric, retroperitoneal.
Perisplenitis.
Fibrous endocarditis tricuspid.
Fibrous endocarditis ventricular.
Pachymeningitis.
Leptomeningitis.
Prominent olfactories.
Atrophy temporals.
Brain weight 1475.

c) Special Anatomical Description of Brain.

The meninges were edematous and there were some extensive adhesions between the dura mater and the pia mater, always a condition suggestive though not demonstrative of syphilis. The sulci were broad and even from the outside the brain showed evidence of atrophy. Noteworthy were a few lenticular cystic areas on the surface of the brain similar to vacuolated areas in the substances on section. Very remarkable was the preservation of the cortical tissues in areas immediately adjacent to cysts of the white matter. The basal ganglia area was in general not affected by such cyst-like lesions.

Professor W. T. Councilman of the Harvard Medical School took a great interest in this case on account of its partial resemblance to a previous case under his observation and we here embody a portion of Dr. Councilman's description.

From a case of Doctor Taft's. The case that of a boy 9 years of age, from an asylum for feeble-minded. Not sure, but probably syphilis. Arteries at base of brain normal. The meninges are oedematous; an area on the surface which consisted in a very great thickening of the meninges with seeming adhesions of dura at the point was possibly organization of exudate. This on one side.

The pia easily stripped. The cortex shows a general atrophy, sulci large, the atrophy in places showing definitely on the surface. The surface also showed a few lenticular-like nodules; the section of brain shows areas, apparent vacuoles, around all of the blood vessels of the cortical white matter. A general atrophy of the grey matter, this seemed unaffected, and the places so prominent in the white matter, adjacent to the cortex, did not show in the cortex. The basal ganglia were unaffected; no such lesions in the pons or medulla. The cord not examined. The lesions in this case present a striking similarity to the lesions which were observed in case H-15-73.

The brain as received has the hemispheres separated. The meninges have been removed from the right hemisphere. On the left hemisphere a block of tissue has been taken. The left hemisphere shows the meninges in general slightly thickened and somewhat opaque. The sulci are rather more apparent than usual. The thickening of the meninges most marked along the longitudinal fissure; and on the inner side, extending pretty well over the lateral surface of the frontal lobe, back to the posterior central convolution, down over the fissure of Sylvius, is an area 12×6 cm., extending anteriorly to within 2.0 cm. of the frontal edge of the brain. The meninges are very greatly thickened, and there seems to be a membrane which is adherent to the meninges beneath, which can be partially separated from them, which is slightly brownish. There are tags which show adhesions between this membrane, which is not dura, and what is probably the dura above. One cannot be absolutely sure however, that this is not an area of dura which was adherent to the inner meninges, and which has been cut off. All the ventricles of the brain are very greatly dilated, the dilatation being especially marked in the aqueduct. The meninges over the cerebellum, which have not been removed, are somewhat thickened and cloudy, and there is a well marked cerebellar herniation into the foramen magnum. There is a wider space than usual between the lobes of the cerebellum. The ependyma of the dilated lateral ventricles seems cloudy and slightly granular. The right hemisphere shows on its mesial surface a very well marked atrophy of the convolutions. All convolutions share in this, but the atrophy seems particularly marked in the marginal convolution. At several points here the inner meninges clung on removal, and small areas of cortex were removed with them. The surface of the atrophied convolutions is not smooth, but greatly wrinkled, there being definite depressions at various points. There is no particular abnormality in the run of the convolutions. The atrophy is probably rather more marked in the entire frontal region of the brain than elsewhere, and projecting from the region here there are small flattened elevations from 1 to 2 mm. in width, projecting about $\frac{1}{4}$ mm. above the surface. They give the impression of small flattened discs directly placed on the surface. There are several of these, the largest of them being in the operculum, and in this immediate region there are five. On the surface of the parietal lobe there are similar areas, though smaller. There

is a peculiar appearance in the upper mesial edge of the first frontal convolution; the sulcus here is very wide, and there is the appearance as though the atrophy were very much more marked immediately below the surface than elsewhere. The least atrophy is in the occipital lobe. It is very well marked in the temporal lobe, especially in the first temporal convolution. It does not seem to have affected particularly the area of the Island of Reil, although it is evident to some degree in all parts of the brain. The arteries at the base of the brain are normal and over the cerebellum the depressions formed by the skull are extremely prevalent. This case will be further studied in the sections which will be obtained from Doctor Taft. It is especially interesting in relation to the extreme dilatation of the ventricles, because this would seem to be due possibly in part to the contraction of the brain, a dilatation ex-vacuole, and also partly to the chronic meningitis interfering with the excretion of the cerebrospinal fluid.

A section of this brain which was given me by Doctor Canavan shows a very great thickening of the meninges, the section being taken from the area of thickening, and this shows that the thickened mass is not dura. It contains on its surface, and near the surface, a lot of very black blood pigment, from formalin hardening, and the membrane itself is formed of very dense bands of connective tissue, with wide spaces between. The surface of the brain is very oedematous. There is very marked granular disintegration of all of the pyramidal cells, without any Nissl bodies, the cells being simply filled with granules. The most prominent thing in the section, however, is seen in the peri-vascular spaces, which are enormously dilated, and which, unlike a previous case, contain a considerable amount of tissue within them which is attached to the vessels, and around the margin of the peri-vascular spaces there is very marked gliosis. All this will be studied further.

d) Microscopical Examination.

The cortex from various regions, stained with Haematoxylin and eosin, phosphotungstic haematoxylin, and Cresyl-violet. There is not a sharply defined marginal gliosis. The sub-marginal layer is oedematous, and contains numbers of glia cells, usually stellate, but there is not an abundant formation of fibrils. Blood vessels of the grey matter generally are injected, abundant. There is, however, in the grey matter, no marked dilatation of peri-vascular spaces. About some of the larger vessels however, there seems to be some tendency towards this. In the grey matter in most areas there does not seem to be any increase in the glia cells save in a layer immediately below the margin. In the upper layers of the grey matter occasionally spider cells are found. There is a great deal of degeneration in the nerve cells. The large pyramidal cells are relatively in the best condition. The other cells have pale protoplasm, which is sometimes glassy, and have a marked increase in granules, but the Nissl bodies are not apparent. The nuclei generally are present at one end of the cell, often protruding from the contour. There is a sharp change, however, in the white matter, and the most marked thing here is the dilatation of the peri-vascular spaces, which is nearly universal, but much more accentuated in certain places. In these peri-vascular spaces generally the vessel lies in the center of the space, supported by a thin mesh-work of tissue which is not neuroglia, but represents apparently a growth of tissue coming from the vessels. It is very loose in its general character, and in places seems to consist chiefly of cells which are connected together by their processes, forming a very delicate network. Around the margin there is an increase of neuroglia, and neuroglia fibrils to some extent project into the tissue. In this loose net-work compound granule cells are found. In places the net-work does not extend all over the space. It has apparently been pulled from the margin of attachment. In other places in place of the net-work there is a definite tissue, seemingly of connective tissue origin, and in many of the spaces the compound granule cells are much more abundant. There is a great deal of variation in the degree of ganglion cell degeneration; in places extremely marked, and in all cases the pyramidal cells are the least affected. The process as studied here seems to be in its general features very similar to the conditions seen in the case of syphilis of the brain,

and to be brought about by the action of a substance which primarily leads to an injury in the white matter of the brain, making itself apparent chiefly in the region around the vessels. The process here, however, would not seem to be so advanced as in the other case of cerebral syphilis, this being apparent in the presence of the compound granule cells, indicating a continuation of the process of disintegration.

The gross Weigert sections show an extensive hydrocephalus which reaches a higher degree in the posterior and lower cornua of the lateral ventricles. It is slightly greater on the left side, the anterior limit of the lateral ventricle here extending farther front. In general on this side the various tracts and nuclei such as the internal and external capsule, the caudate nucleus and the corpus striatum are smaller. The normal proportion of white matter to grey is disturbed in favor of the latter in the periphery more posteriorly by the numerous perivascular dilatations and in the deeper regions of the brain by the pressure of the hydrocephalus.

Throughout the white matter there is a marked degree of perivascular dilatation: this consists of an enlargement of the spaces about the vessels in which the vessel itself appears small in comparison usually placed somewhere near the center of the space and surrounded by varying amounts of a loose cellular tissue (Fig. XVIII, u, v, w). These vascular dilatations are more numerous and larger in the middle and posterior parts of the brain. At the level of the posterior part of the optic thalamus the white matter is almost riddled by these dilated spaces, forming only a connecting network around them.

d) Microscopical Summary.

Considerable subpial gliosis.

Larger cells swollen at base — nucleus pushed toward apex.

Much general glia cell increase especially in white substance, including amyloid forms — occasionally rod cells.

Perivascular spaces in white substance much enlarged and filled with loose meshed connective tissue in which are frequent compound granule cells and a few small round cells with an occasional plasma-like cell. Sometimes several small vessels in the space. No perivascular change in grey matter. Capillaries numerous and prominent everywhere. Marchi shows moderate reaction in posterior columns of cervical spinal cord. None in cortex.

The tracts show no degeneration by the Weigert method. The white matter besides being considerably compressed by the hydrocephalus, is riddled by the cystic dilatations of the perivascular spaces, mentioned elsewhere.

e) Anatomical and Histological Summary.

Subsequent to the autopsy and microscopic examination of this case a further investigation of the family condition was made by Dr. Walter E. Fernald. There seems to be no doubt of the syphilitic nature of the condition even from the clinical standpoint as a competent physician was found who had treated the father for this condition.

The brain weighed 1475 grams, a gain of over 500 grams over an estimated weight by Tigges' formula. The child had several external anomalies; high placed teeth, unusual thickness of bones, 'wild' hair, malformation of skull and brain.

The membranes of the brain markedly thickened suggested on inspection an advanced meningo-encephalitis. The gross sections showed a marked cystic state of the white matter, and a hydrocephalus. The microscopical examination shows cystic space about vessels and palm leaf-shaped nerve cells with collection of stainable protoplasm at their major axon.

U. Low power view of section showing cystic degeneration.

V, W. High power view. Note ingrowth of peculiar cells about vessels running through cysts. (See description, Case XVIII, under item **d**.)

Synopsis of Findings, Case XIX.

a) Clinical.

1. Physical Examination.— R. Hal., male, born Sept. 28, 1892, admitted Feb. 1, 1912, and died Dec. 4, 1915. Feb. 2, 1915, patient at the age of 21 weighed 112 lbs., was 5′ 3½″ tall, well developed and nourished, with horny materials upon the soles of the feet and over the knees. Hands hard and horny. Ulcerations over each tibia. Cranium circumference 19¼″, cephalic index 73.52. Face characteristically Mongolian, asymmetrical, small, well-shaped ears; tonsils enlarged, several teeth missing, some decayed, transverse fissure of tongue. Wassermann reaction had been negative December 1914.

2. Family History.— Patient's father was 25 years of age and mother 22 when patient was born. Patient the elder of two children; delivery difficult; instrumental.[1]

3. Personal and Developmental History.— Patient walked at one and a half years, talked at two years; had scarlet fever, measles and chicken pox before admission. For a Mongolian, health at institution exceptionally good. Moist eczema of both legs; this was relieved by institutional care, but had returned after patient's return home. Patient had been admitted to the school for the first time on July 7, 1904, at 11 years, being at that time a bright-looking boy, able to talk. After four years of sense and hand training, patient could do most of the exercises. He was taken out by his family in 1909 and failed considerably before re-admission in 1912, having grown thinner and less alert.

4 and 5. School Progress and Examinations.— See above.

6 and 7. Practical Knowledge and Economic Efficiency.— Nil.

8. Social History and Reactions.— Not very talkative unless spoken to, but then would talk a good deal. Habits tidy, easily interested in things about him; liked to play games; was able to read a few words.

9. Moral Reactions.— Quiet; inoffensive.

10. Psychological Tests.— 5.2 Binet performed Aug. 13, 1914.

Waverley School History.— Transferred to Templeton Colony, patient improved mentally and physically, gaining in weight and becoming more alert. After being brought back to Waverley, in Dec. 1914, eczema grew worse but was cleared up under arsenic treatment. Patient died of typhoid fever Dec. 4, 1915.

b) Autopsy.

Body of a slender, fairly well nourished white male, 160 cm. in length. *Skin* red in blotches over abdomen, brown scales over knees. Shins thick and leathery, brown in color. In center of thickened areas occur eroded areas measuring 5 × 2 cm., 3 × 2 cm., 3 × 4 cm. No edema, no palpable lymph nodes.

Circumference of head, 48.0 cm., mento occipital 36.0 cm. Interparietal not taken.

Ventral Section.— Fat over abdomen 0.8 cm., over chest 0.5 cm. *Muscles* deep red except near

[1] An elaborate study of the family history was made by Miss E. C. Macomber. The chart shows three examples of feeble-mindedness in patient's fraternity, and three in the parental fraternity; there are three instances of cancer in the parental fraternity and two in the grandparental fraternity, and one in the great-grandparental fraternity. Patient's father is stated to be not very bright and to be peculiar.

insertion of recti; muscles which are mottled grey (? Zenker's necrosis). *Omentum* scant in fat. *Lower border of liver* 10.0 cm., *transverse colon* 15.0 cm., below ensiform. *Spleen* blue in color and adherent. *Mesenteric lymph nodes* enlarged and reddened. Lower end of ileum shows dark red fibrin over last 2.5 cm. *Coecum* appears whitish blue in spots. *Appendix* 8.0 cm. in length, bound down by adhesions. *Diaphragm* arches to fifth interspace on each side.

Thorax.— There are hemorrhages at base of right lung anterior. Slight excess of fluid in pericardial sac. Mesenteric, bronchial and retroperitoneal lymph nodes markedly enlarged.

Heart.— Weight, 195 grams. Measures 10 × 10 cm. Coronaries negative. Epicardial fat abundant.

Measurements: T. V. 12.0 cm. P. V. 5.0 cm. L. V. 0.5 cm.
M. V. 10.0 cm. A. V. 7.0 cm. R. V. 0.6 cm.

Fenestrations marked in pulmonary valves. Endocardium grey.

Lungs.— Right lung weighs 680 grams, left 435 grams. Anterior and upper portions of right lung of normal appearance. Posterior and lateral are dark red, mottled grey areas surrounding bronchi.

Left lung negative in appearance, except section shows multiple hemorrhagic cavities surrounding bronchi. Pin points of pus spurt from some of these areas.

Organs of the Neck.— Not removed.

Adrenals.— Not separable from kidneys.

Kidneys.— Combined weight kidneys and adrenals, 285 grams. Kidney measures 11 × 4 cm., cortex 1.0 cm. to 0.6 cm. Capsule intimately adherent. Cortex evenly grey and soft. Apices of pyramids white, red at base. Pelvis not remarkable. Kidney tissue very friable. Other kidney same.

Liver.— Weight, 1585 grams. Measures 21 × 18 × 7 cm. Color deep red, appears somewhat grey. Gall bladder contains somewhat stringy yellow fluid.

Spleen.— Weight, 195 grams. Measures 14 × 8 × 7 cm. Three foetal lobulations. Capsule somewhat thickened. Pulp deep red. No Malpighian bodies visible.

Gastro-Intestinal Tract.— Stomach. Mucous membrane pink. Rugae present. Duodenum: bile stained, otherwise negative. Jejunum: lower part dry. Ileum shows area of faint injection not unlike " rose spots " on upper portion. A little lower a circular ulcer with indurated edges is seen. Lower third markedly congested, shows multiple ovoid ulcers. Peyer's patches not apparently involved. Colon from coecum to rectum beset with oval ulcers measuring 0.3–1 cm. in diameter. These are shallow and red edged. Some show lace work of crisscrossing at base (healing ?).

Head.— Calvarium: frontal 0.2–0.3 cm., occipital 0.3–0.4 cm., temporal 0.2 cm.

Dura mater not adherent; convolutions seen through it. Pia mater injected. Slight suggestion of subpial diffusion of blood.

Palpation shows brain firmer than normal. Right hemisphere appears narrower than left, measures 1.0 cm. more in width at base of frontal lobes.

Base of Brain.— Olfactory bulbs show destruction. Nothing of note in optic nerves. Slight thickening of pia. Greatest width prefrontal, 3.0 cm., frontal, 8.0 cm., mid portion at pons, 14.0 cm., greatest length, 15.5 cm.

Vessels show no anomaly, no sclerosis.

Convolutional pattern not more complex left side but there appears to be more convolutions. Notable windings of angular and supramarginal gyri on left. Brain shows notched occipital poles.

Brain weight, 910 grams. Tigges' formula 8 × 160: 1280 grams. Loss in weight, 370 grams.

General Appearance and Anomalies.

Fairly nourished.
Pigmented skin.
Erosion shins.
Adrenals not separable from kidneys.
Calvarium thin.
Unequal hemispheres.

Acute Lesions.

Zenker's necrosis
Hemorrhagic bronchiectasis.
Fibrinous ileitis.
Dilated heart.

Chronic Lesions.

Periappendicitis.
Perisplenitis.
Mesenteric, bronchial, retroperitoneal lymphnoditis.
Relative stenosis pulmonary and aortic valves.
Cardiac hypertrophy.
Interstitial nephritis.
?Tuberculous ulcers intestine.
Brain weight, 910 grams.

c) Anatomical Description.

The brain of this Mongolian imbecile was small (910 grams) and the cerebellum and pons were noticeably smaller than usual. There was no special asymmetry of the brain which fitted the school of dolichocephalic type. There was a diminution of the coronal circumference of the brain at the plane of the temporal tips. There was a tendency to " rosette " formation in both of the frontal lobes. Both of the precentral gyri were interrupted by transverse fissures. The gyri were a fair width and their summits closely approximated. The corpus callosum was slightly thinner in its posterior third.

There were some minute cysts of softening in various areas (frontal, temporal) the pia mater was slightly hazy and thickened over the entire brain and over the cerebellum. The blood vessels were, in general, not remarkable.

d) Microscopic Examination.

The existence of the cysts of softening might raise the question of syphilis. There was one focus of a few mononuclear cells regarded as of exudative origin about one of the larger blood vessels in the white matter of one area (left postcentral gyrus) but there were no other evidences of exudate except in the frontal region (neighborhood of cysts).

The neuroglia tissues showed a tendency to increase of cells usually slight but occasionally moderately well developed. Satellite cells were occasionally increased and the neuroglia cells along blood vessels were in a few areas increased.

The nerve cells were in general well preserved and in particular the large cells retained a proper quantity of Nissl bodies. In the area where a focus of small round cells was found (left postcentral) there was a focal scarcity of cells in all the layers. Another section (left superior temporal) showed a nerve cell scarcity in the supragranular layers especially at the crown of the gyrus. A like condition was found in the left superior parietal area. On the whole there was a rather extensive tendency, particularly on the right side of the brain (not confined thereto) to supragranular nerve cell scarcity.

e) Anatomical and Histological Summary.

There were some skin lesions in this Mongolian imbecile somewhat suggestive of syphilis. The Wassermann reaction a year before the patient's death at twenty-three years, had been negative. The case was characteristically Mongolian. The nerve cell losses or replacures did not seem characteristic of syphilitic conditions and are far more widespread than the small evidences of lymphocytosis shown. There was no evidence of plasmacytosis.

Synopsis of Findings, Case XX.

a) Clinical.

1. Physical Development.— L. Dur., male, born Nov. 21, 1877, admitted Oct. 16, 1900 and died Oct. 8, 1915. In March 1914, patient at 36 years of age weighed 131 lbs., was 5′ 5″ tall, well developed and nourished, weak circulation, cyanotic extremities, exaggerated patellar reflexes, with ulcers of both legs; cranium circumference 22″, cephalic index 72; asymmetrical face, deformed ears; ? saddle nose, poor teeth, flat palate.

2. Family History.— Patient one of 5 children, all others stated to be normal. Patient's father was 45 years and mother 36 years at patient's birth: patient fourth child.

3. Personal and Developmental History.— Patient's peculiarity first manifested itself at 5 years by his not learning readily; his head seemed smaller than the average for his age; began to talk at about 3 years but always stammered badly. Patient began to walk at 2 years. Patient had measles.

4. History of School Progress.— Patient had somewhere learned to read and could talk intelligently; was well mannered.

5. School Examination.— Nil.

6. Practical Knowledge.— Patient worked at Templeton Colony out of doors, doing ordinary rough farm work, using grub hoe, pick and shovel well.

7. Economic Efficiency (see 6).

8. Social History and Reactions.— At first well-mannered; of extremely nervous temperament; after being taken home in summer for vacation patient always returned much more disturbed and excited than before going. After a few years at the Templeton Colony, patient began to grow childish, developed bad habits and tendencies, lost interest in his work and began to talk to himself. He was then transferred to Waverley (see below).

9. Moral Reactions.— Proper until mental change above noted; thereafter became very impatient, constantly asking about mail and papers.

10. Psychological Tests.— 6 years; Binet performed Aug. 4, 1914; this reaction is obviously lower than the level which patient would have attained before the mental change.

Waverley School History.— This case apparently developed a mental disease over and above the original mental defect, apparently having periods of delusions and hallucinations, and at times talking and making noises all night, sleeping very little. In March, 1915, patient after having had a long illness with abscess of the thigh, could not talk intelligently. In August, 1915, patient grew thin and pinched, developed diarrhoea, taking to bed; got somewhat better, was up and about in October; took to bed once more and died October 8, 1915. Wassermann reaction Aug. 31, 1915, negative.

b) Autopsy.

Body of a slenderly built, fairly nourished white male, 168 cm. in length. *Skin* white and fine in texture, elastic, rosy grey in color except for a *bruise* 8.0 cm. below right iliac crest, 5.0 × 3.0 cm.; this is purple in color. Scar over right buttocks, 8.0 cm. external to sacral ridge, 3 × 2 cm. From the knees downward the skin is brownish in color surrounding lighter areas ? site of old ulcers. *Abrasions* exist over right knee and left shin in the midst of this brown, shiny area of pigmentation. Marked edema dorsum of right foot; slight edema dorsum of left foot. Skin is scaling over left index finger and slightly over right.

Legs unequal in size; mid calf region, right, measures 28.0 cm., of left 25.5 cm.

Hair.— Slight growth in axillae; marked growth around nipples, moderate amount over thighs and pubis.

External genitalia well developed. No lymph nodes palpable.

Ears.— Right measures 6 × 4 cm.; left 6 × 2.5 cm. Right ear is markedly thickened especially in its upper half and is much broader than the left. Ear lobes not adherent.

The palpebral fissures not large enough to accommodate eyeballs. Pupils — right 0.8 cm., left 0.8 cm.

No teeth present.

Somewhat yellowish flush to face and neck.

Body lies in left lateral decubitus. No bed sores.

Rigor mortis present.

Ventral Section.— Fat over abdomen scant as it is over chest. Muscles deep red in color except intercostals which are paler. The costal angle is broad. Free fluid in peritoneal cavity. *Lower border of liver* 3.0 cm., *transverse colon* 15.0 cm. below ensiform. *Mesentery* contains considerable fat and the lymph nodes are everywhere prominent and red in color. *Omentum* scant in fat. *Spleen* free. *Appendix* 1.3 cm. in length, injected at tip. *Diaphragm* arches to 4th rib on right, 5th on left.

Thorax.— Right pleuric cavity free; left filled to overflowing with reddish fluid. Pericardium uncovered, shows some frothy material in its upper layers. The heart floats in the excess of pale pericardial fluid, estimated at 150 cc. The left lung is adherent lightly to the chest wall.

Heart.— Weight, 255 grams. Measures 10 × 10 cm. Epicardial fat fairly normal. Coronary vessels negative. Tricuspid valve thickened somewhat at edges.

Measurements: T. V. 13.0 cm. P. V. 6.0 cm. L. V. 1.4 cm.
M. V. 10.0 cm. A. V. 7.0 cm. R. V. 0.5 cm.

There is an anomaly in one leaf of the pulmonary valve. The free edges measures 1.3 cm. in length against 2.3 cm. of the other cusps. The free edges of the mitral valve and of the aortic are thickened. The free edges of the aortic valve show some redundancy. Endocardium grey. Myocardium firm. Nothing of note on section.

Lungs.— Weight, left 1360 grams. Right lung is solid to the touch except for a small portion of the anterior edge of the upper lobe. The pleura is covered at intervals with yellowish fibrin. Color of the lung is reddish yellow. On section yellow semi-purulent material follows the knife and the lung substance is granular and mottled yellow and red. A section sinks abruptly in water. Right lung contains three lobes. There is congestion of the postero-lateral section. Frothy fluid follows the knife. Slight granular change over pleura and congestion of the lung substance.

Organs of the Neck.— Not removed.

Abdomen.— Spleen. Weight, 145 grams. Measures 11 × 7 × 1–2 cm. There are three foetal lobulations on the inferior border. Capsule somewhat thickened but is of a normal slate color. Section shows pulp firm and dark red. Trabeculae not increased. Malpighian bodies not notable.

Adrenals.— Plump and firm. Section shows one to have a greyish center.

Kidneys.— Combined weight, 395 grams. One measures 11.5 × 6 × 3 cm. Capsule slightly thickened; strips with some difficulty tearing portion of cortex. Cortex measures 0.7 cm., is pinkish-red. At one point a small grey body is embedded in the base of a pyramid. This is pinhead in size. Pyramids six in number, injected at bases. Other kidney measures 12 × 7 × 4 cm. and answers same description except that there are 5 pyramids.

Liver.— Weight, 1585 grams. Measures 28 × 20 × 8 cm. Color red dotted with yellow. Capsule somewhat thickened. Section shows lobules well outlined. No apparent increase of connective tissue although the knife is somewhat resisted. Gall bladder dilated; contains clear brownish fluid.

Pancreas.— Negative.

Gastro-Intestinal Tract.— Stomach somewhat dilated; shows no rugae. Mucous membrane grey, drips mucus. No change in upper tract. Six centimeters from ileo-coecal valve is a firm area which shows internally as a vast ulcer. This is irregular and measures 4 × 4 cm. in its massive portion and extends in a serpiginous manner to a maximum of 7.0 cm. Edges are indurated and sloughing, base

extends nearly to serosa. Surrounding this area the mucous membrane is dotted by small ulcers that are somewhat red edged and somewhat constricted at the point of ulceration. The remainder of the tract is free.

Genito-Urinary Tract.— Prostate and bladder not opened. Testicle not examined.

Retroperitoneal Tissues.— Aorta elastic. Sympathetic and peripheral nerves negative. Some lymph nodes along the line of aorta but these are not injected and appear pinkish in color.

Head.— Hair clipped close. Scalp markedly adherent to calvarium. Calvarium measures frontal 0.6 cm., temporal 0.4 cm., occipital 0.9 cm. Middle meningeal artery grooving shallow.

Dura mater not adherent but is thickened evenly. Longitudinal sinus contains yellowish grey adherent clots.

Pia mater somewhat injected and somewhat thickened in sulci.

The prefrontal lobules are indicated by triangular depressions. There is fair complexity of convolutional pattern which is slightly less marked in right of brain. The right parietal is much more simple than the left. The gyri in the frontal region appear small, especially on the left.

There is resistance to the examining finger over the superior surface of the brain and over the inferior surface.

Base of brain.— The first and second nerves are negative; 3rd nerves are involved in a thickening of the pia mater which surrounds them. Vertebral arteries white as is basilar and midcerebrals. Pons and cerebellum firm as are olivary bodies.

Base of Skull.— The posterior clinoid processes measure 2.0 cm. in width; middle clinoid processes 0.3–0.5 cm. The pituitary appears to be walled in and the dura mater which covers it and the stalk of the pituitary is markedly thickened.

Middle ears and Gasserian ganglions negative.

Brain weight, 1390 grams. Tigges' formula 8 × 168: 1344 grams. Gain of 46 grams.

Cord not remarkable on section, appears firm.

General Appearance and Anomalies.

Fairly nourished.
Abrasions, bruises, scars and pigmentation extremities.
Edema feet.
Scaling skin over fingers.
Left lateral decubitus.
Broad costal angle.
Unequal legs.
Unequal ears.
Small palpebral fissures.
Anomaly aortic valve.
Absence prefrontal poles.
Microgyria.
Unequal parietals.

Acute Lesions.

Lobar pneumonia.
Parenchymatous nephritis.
Ulcer intestine ? dysenteric.

Chronic Lesions.

Hydrothorax.
Hydropericardium.
Chronic adhesive pleuritis.
Chronic fibrous endocarditis (valvular).
Hypertrophy heart.
Perihepatitis.
Dura thick.
Pia thick.
General cerebral gliosis.
Thickening vertebral arteries.
Thick pituitary stalk.
Brain weight 1390 grams.

c) Special Anatomical Description of Brain.

The brain was of good size (1390 grams) and of a dolichocephalic type. The convolutions are of fair width, slightly flattened everywhere. A number of anomalies are in evidence; left precentral gyrus interrupted by the first frontal gyrus; right post central interrupted at superior knee; tendency to rosette formation, left intraparietal sulcus; operculum on both sides cut by central fissure; absence of middle commissure. The corpus callosum was thin in both its anterior and posterior third. The basal vessels were small and rather noticeably thickened. The pia mater was slightly thickened and hazy.

d) Microscopic Examination.

Practically all the sections show identical changes though varying slightly in degree. There was a slight moderate increase of neuroglia fibres in the subpial zones, chiefly at the bottoms of the sulci, with focal increases of cells in places. The large Betz cells contained normal appearing Nissl bodies and small amounts of pigment. Satellite cells are numerous, appearing in all cell layers. There was a rather marked increase of neuroglia cells of all forms, both cells producing fibrils and cells with well marked protoplasmic processes. These neuroglia cells were apt to show an increase in groups especially about capillaries. Sometimes there was a small pin-point group of radiating neuroglia cells suggesting a small focus of special degeneration or infection. In the vessel spaces of the medulla and the cerebellum there was even evidence of a slight infiltration with mononuclear cells but in the cortex itself there have not yet been found evidences of chronic inflammation.

e) Anatomical and Histological Summary.

The question again arises for this imbecile, whether he is not syphilitic. It will be remembered that he developed a mental disease with delusions, hallucinations and insomnia over and above his original mental defect. The Wassermann reaction five weeks before death was negative.

The following are brief characterizations of the cases in the present Waverley Research Series (XI–XX), which may be helpful for quick reference and are drawn up like those in the first series (I–X), pages 105–108 of Researches, 1918.

Case XI. This is the first classical "big-head" hydrocephalic of the Waverley Series (Case XII was the second). The value of the case *re* possible syphilitic origin of the "big-head" cases is injured by the tuberculosis which affected the brain before death. Tuberculosis of membranes and substance is associated with exudation, hard or impossible to tell from that of syphilis of the nervous system. The Binet age of Case XI was 1.2 (actual age at death not quite 6 years). The clinical history indicates that little or no further progress was to be expected. The superimposed acute lesions interfere with our judgment whether the nerve cells are hypoplastic (in the sense of a primary arrest); but there is considerable evidence of nerve cell scarcity.

Case XII, the second "big-head" hydrocephalic of the Waverley Research Series immediately followed the first (Case XI). We do not know the actual weight of Case XII's

brain (technical attempts to fix brain in formalin in a certain manner forbade taking its weight); but the weight minus contained fluid was undoubtedly over 1000 grams and probably over 1100 grams. The Binet age of this twenty-year old hydrocephalic was 3.4, a considerable advance of the 1.2 scored by the preceding case (XI). *Re* the possible relation of "big-head" hydrocephalus to neurosyphilis, we find some suggestive foci of chronic inflammation (plasmocytosis), which can be explained by no other hypothesis so easily as by that of syphilis (the cause of death was acute pyelonephritis, and there seems no way of connecting the chronic inflammatory brain foci either with this pyelonephritis or with other existent lesions). The aqueduct of Sylvius was definitely bridged over by neuroglia tissue.

Case XIII. This is the first case of Mongolism in the Waverley Series (Case XIX is another, and three more have since come to autopsy, for description as cases XXI, XXVIII, and XXIX in a third monograph to follow this). The general suspicion concerning Mongolism is that endocrinopathy plays some part therein. Some authors incriminate neurosyphilis; but the numerous microscopic sections thus far examined in Case XIII show no sign of chronic inflammation whatever. *Re* endocrine changes, there was, besides a general *status lymphaticus* or lymphatism (bronchial, mesenteric, retroperitoneal), a persistent thymus, with indications of hypothyroidism, hypoadrenalism and hypopituitarism. But of course the persistence of the thymus in a girl of 18 should not be overstressed. The nerve cells appear thinned-out in various loci. Gliosis was but moderate.

Case XIV. This idiot of 32 (Binet age, 1.3) is in some respects more typical of what we might term "ordinary" low-grade custodial school cases than any other case since Case VI of the first series (but even Case VI had but one vocal cord and showed other stigmata, which served to raise the syphilitic hypothesis). The syphilitic hypothesis can be raised for Case XIV (foci of mononucleosis, even plasmocytosis). The translocation of nerve cells into the white matter is a finding, however, that is either non-syphilitic in origin or is due to some effect excited by syphilis in a peculiar way and probably at an early stage of development. There were no striking lesions or disproportionate appearances in the endocrine system. How important the datum, if we could be confident that no mental change began until the sixth year after a scarlet fever!

Case XV. This case, like XIV, raises again the hypothesis of syphilis (some plasma cells in the meninges and a few foci of mononucleosis); but abscess of liver, otitis media and mastoiditis may have contributed the exudative elements to the brain. On the whole Case XV belongs to the group of unresolved cases (after syphilis, direct brain injury or lesion, and endocrine changes have been thrown out of consideration as insufficiently supported hypotheses). There is, of course, no lack of histopathology of the cerebral cortex

to account for the imbecility (Binet, 2.4 years); there is a well marked poverty of nerve cells, often more marked in the outer layers (supragranular). But the question remains, What was the cause of this cell-scarcity? Is it a hypoplasia with early death of cells having low vitality? Or is it an instance of genuine agenesia in the sense that numerous nerve cells failed to get laid down altogether? Perhaps the latter, since the heterotopia of nerve cells (translocation into white matter) found in Case XIV is not much, if at all, in evidence in Case XV. If we interpret that heterotopia of Case XIV as due to lack of "drive," of *élan vital*, sufficient to carry them out to their proper places, we have some basis for suspecting for Case XIV a degree of aplasia or hypoplasia, rather than an agenesia. Apparently neither XIV nor XV is suspiciously endocrine in general appearance.

Case XVI. This striking case of macrogyria (the "loaf-of-bread" brain) presents problems of its own. The greatest problem no doubt is the cause of the failure of sulcation to develop over the whole top and fore parts of the brain, while at the same time no proper layering was going on inside the brain substance. Now this poor furrowing outside and poor layering inside go hand in hand: as one passes backward and beneath zones of more normal furrowing, one comes upon much better layering, until in the occipital poles there is, if not a normal, then a somewhat familiar looking lamination. Another pretty problem here is the relation of a fairly well developed corpus callosum to an otherwise poorly developed brain. In general, with this brain, we are evidently dealing with some mortific agent or some development-arresting agent, operating in the embryonic life and paying heed not so much to architectural details as to certain major trends on the part of the brain. Which is primary, the flaw in the furrowing process or some hypoplasia of lamination?

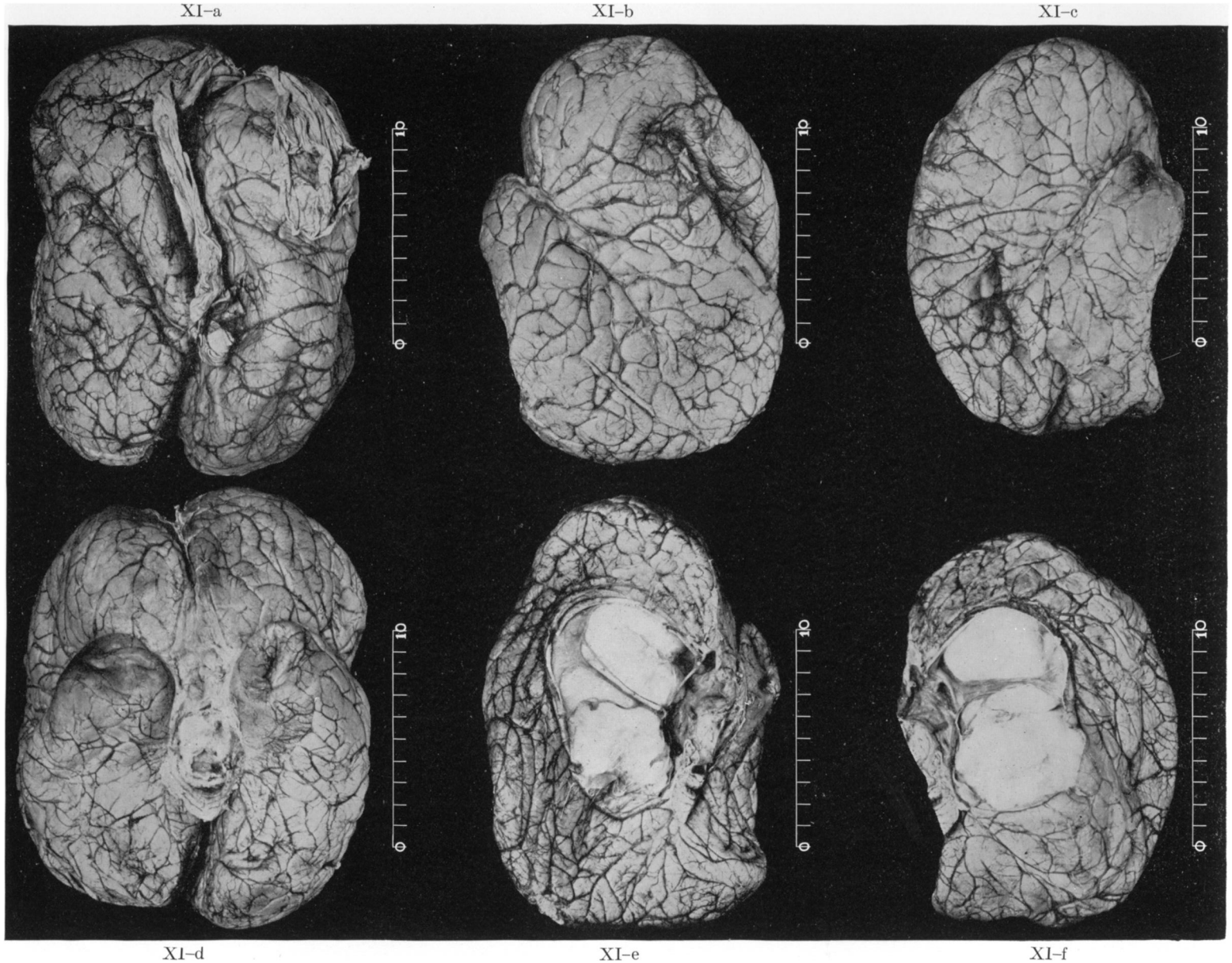
Case XVII. This case is the first to classify amongst higher imbeciles in the second Waverley Research Series (Cases XI to XX). The Binet age of Case XVII was seven. There were two cases in the first series having this age; but one of them (Case III) was the case of "Little Zip" whose brain weighed but 610 grams so that only Case IX of the previous series with Binet age seven is directly comparable with Case XVII. Cases IX and XVII with Binet age seven may also be compared with Case XX, Binet age six. The gross appearance of the brain of Case IX was characterized by exceedingly poor moulding, and certain areas of the brain histologically showed stratigraphical alterations of architecture without complications of acquired degrees. In particular the case of the able-bodied imbecile IX, showed heterotopia of nerve cells recalling those described in the present monograph for Case XIV but Case XVII fails to show translocated nerve cells in the cerebrum (slight heterotopia of Purkinje cells in the cerebellum). Accordingly the brain of Case XVII is unlike that of Case IX and that of Case XIV in the important respect of

heterotopia: that is, we argue that there is less evidence for aplasia or hypoplasia (as indirectly indicated by heterotopia of ganglion cells) than in Cases IX and XIV and that Case XVII with its Binet age of seven more resembles Case XV with its Binet age of 2.4 than either of the other cases mentioned. There are no endocrinopathic suggestions about Case XVII. No sign of exudate was found.

Case XVIII. This altogether remarkable case of multiple small cysts with mononuclear cell (including plasma cell) infiltration turned out to be beyond much question syphilitic (histological and clinical evidence). There was a considerable internal hydrocephalus presumably *ex vacuo*, that is, due either to the destruction or the faulty laying down of white matter. Despite the comparatively complex furrowing of the brain, the corpus callosum was very ill-developed.

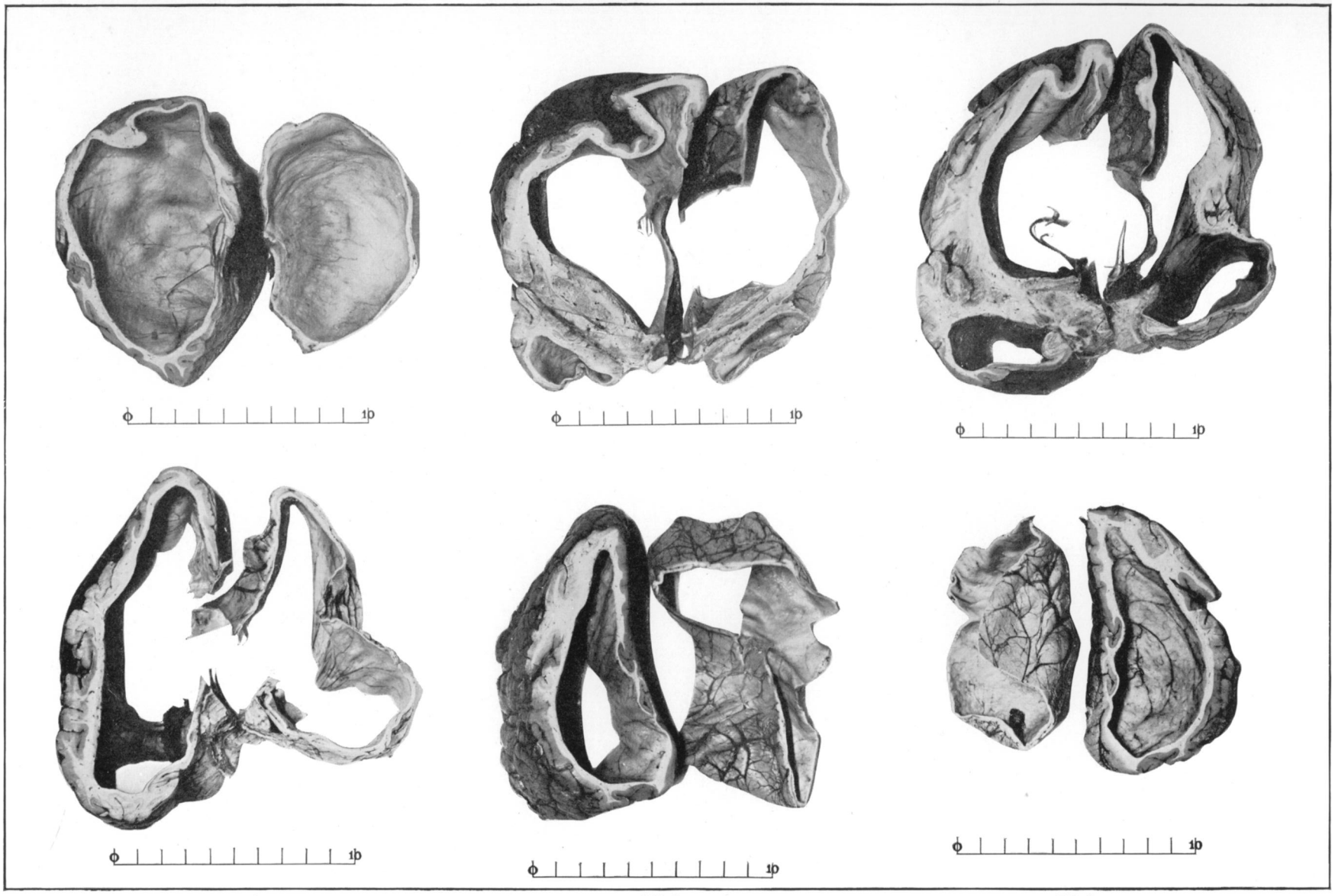
Case XIX, like Case XIII of this series, was a victim of Mongolism but attained a higher mental age (5.2 as against 3.1). It was noted under Case XIII that there were no lymphocytes or plasma cells found in the areas so far examined, and this was adduced in partial evidence that Mongolism was probably not a matter of neurosyphilis. Case XIX does, however, show a few instances of perivascular infiltration about vessels in two or three areas of cerebrum and cerebellum. No definite plasma cells were made out. There is some question of tuberculosis in the shape of ulcers of the gastro-intestinal tract (histologically not proved), and there is some suggestion of a syphilitic skin lesion of the legs. The Wassermann reaction has been negative. The patient died of typhoid fever and it is probable that the intestinal ulcers were typhoidal. It is curious that the brain of this Mongolian with a Binet age of 5.2 should weigh 910 grams as against the brain weight of 1160 grams in a Mongolian with a Binet age of 3.1. To be sure the Mongolian with the lower mental age (3.1) had a lower actual age (18) than the Mongolian with the mental age 5.2 (actual age 23). It may be remarked that the other organs of the body in Case XIX did not show especial diminution of weight.

Case XX. This case was remarkable from its developing over and above the original mental defect also a well marked psychosis (delusions and hallucinations). The patient had always been nervous. There was evidence in the histology of the cortex of somewhat focal degenerative processes (e.g. pin point groups of radiating neuroglia cells and sometimes mononuclear cell infiltration). The question of neurosyphilis may be raised for Case XX with more assurance than for several other cases with signs of exudative change.



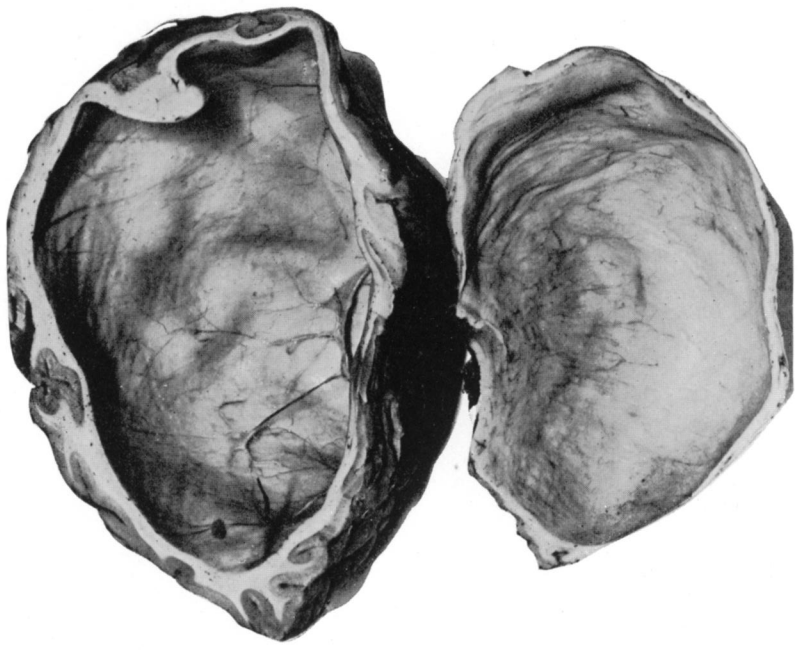
CASE XI — HYDROCEPHALIC IDIOT

XI–g XI–h XI–i



XI–j XI–k XI–l

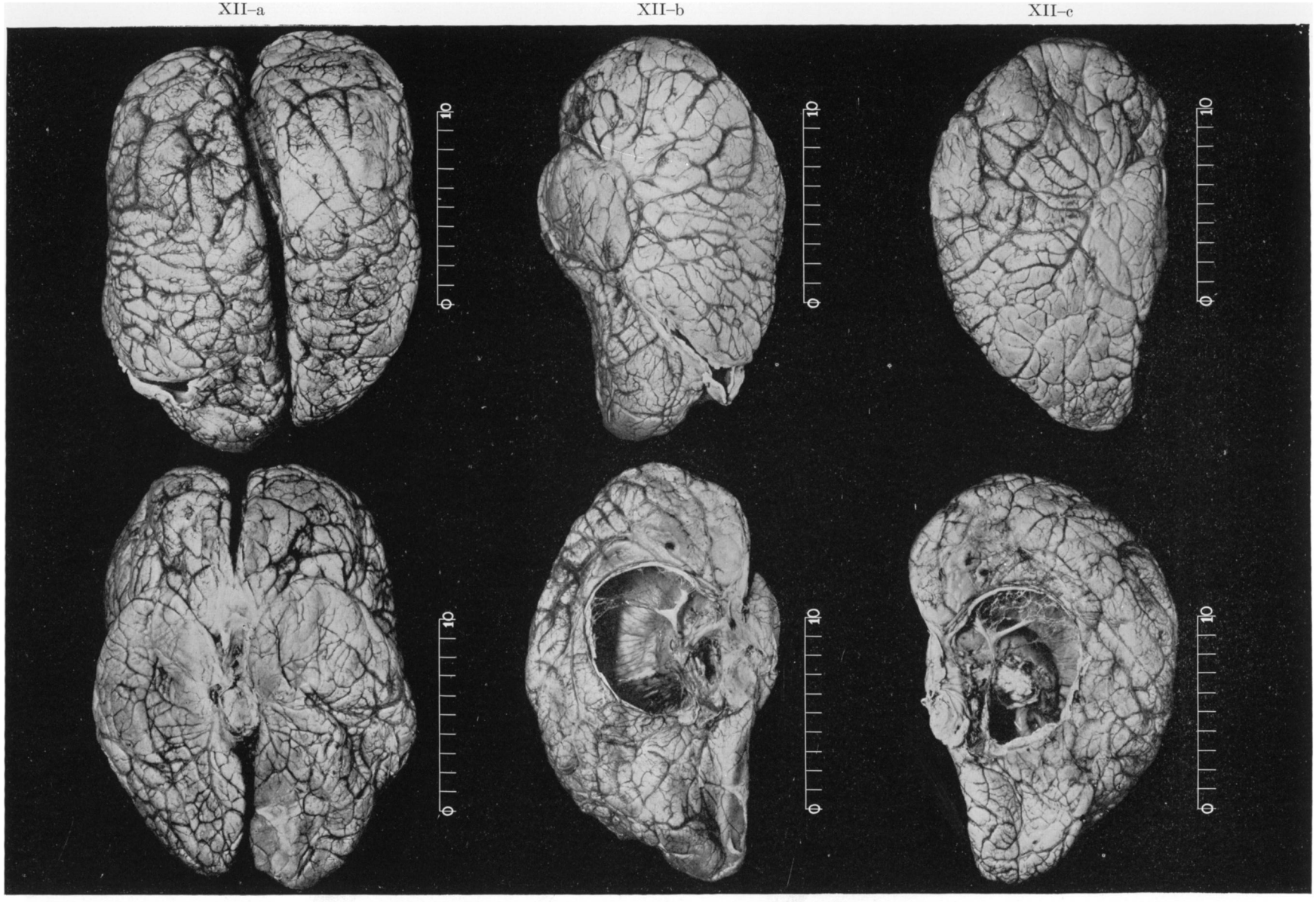
CASE XI.—HYDROCEPHALIC IDIOT



XI–m

XI–n

CASE XI — HYDROCEPHALIC IDIOT

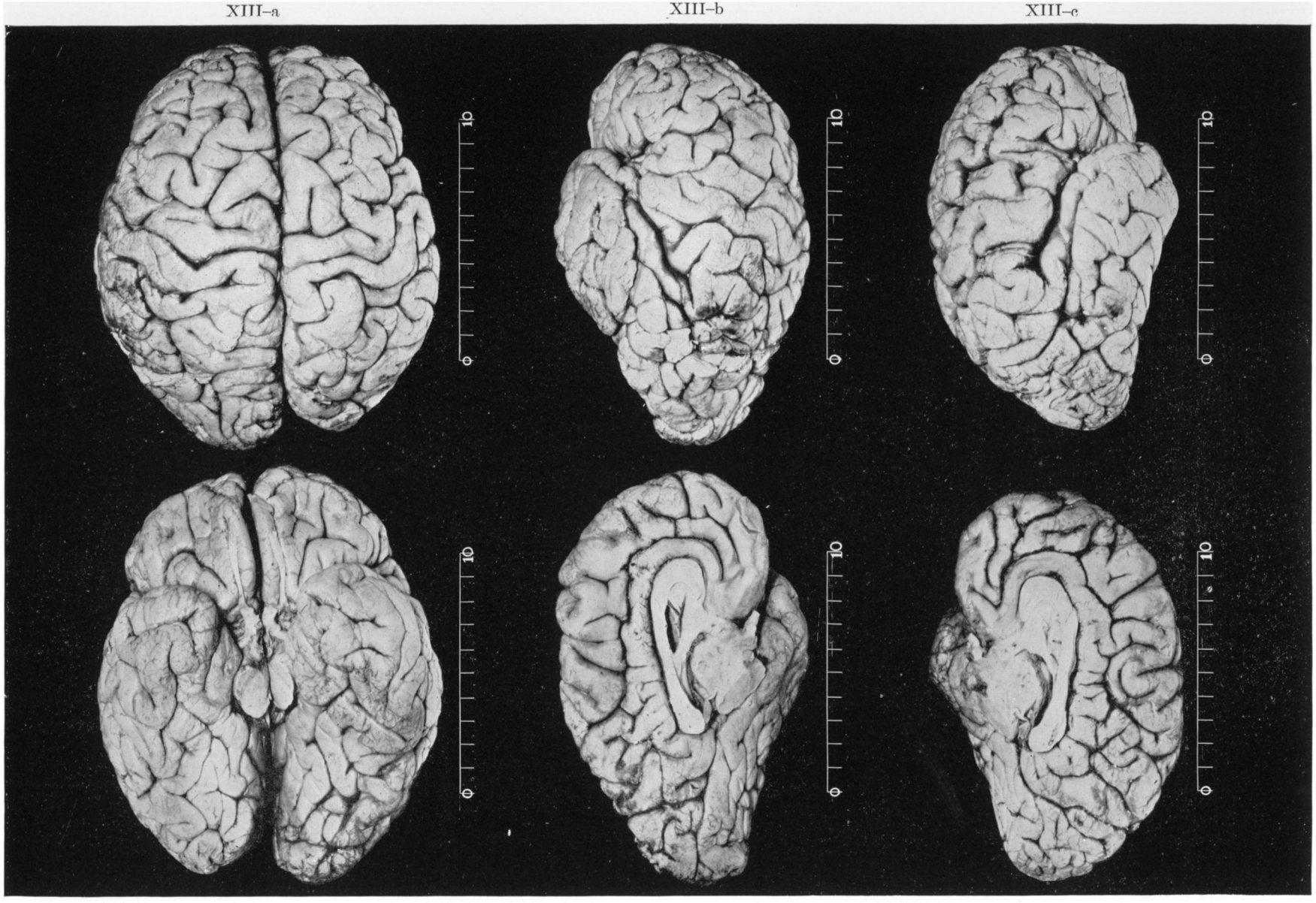


CASE XII — HYDROCEPHALIC SYPHILITIC

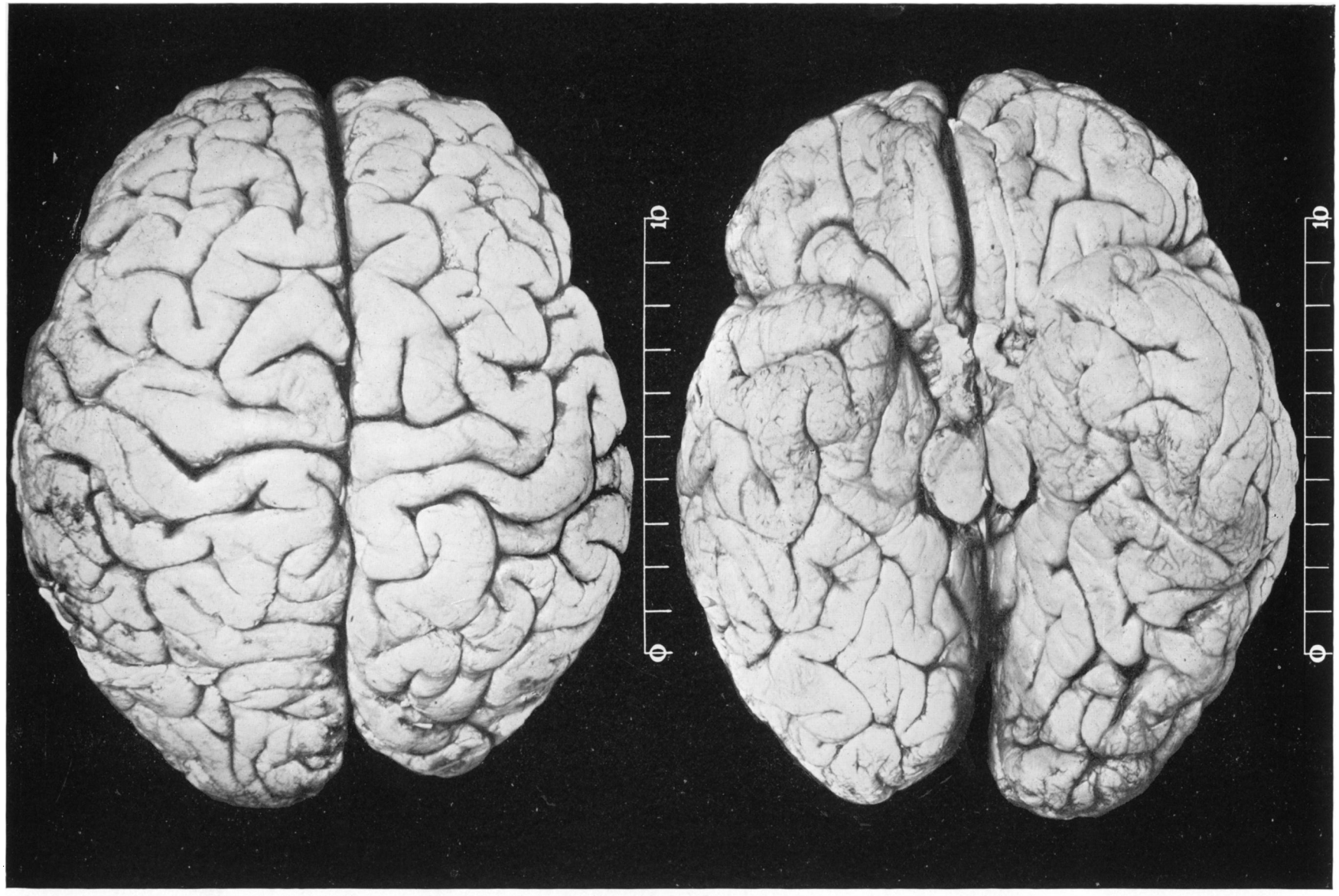
CASE XII — HYDROCEPHALIC SYPHILITIC

XII–o XII–p

CASE XII — HYDROCEPHALIC SYPHILITIC

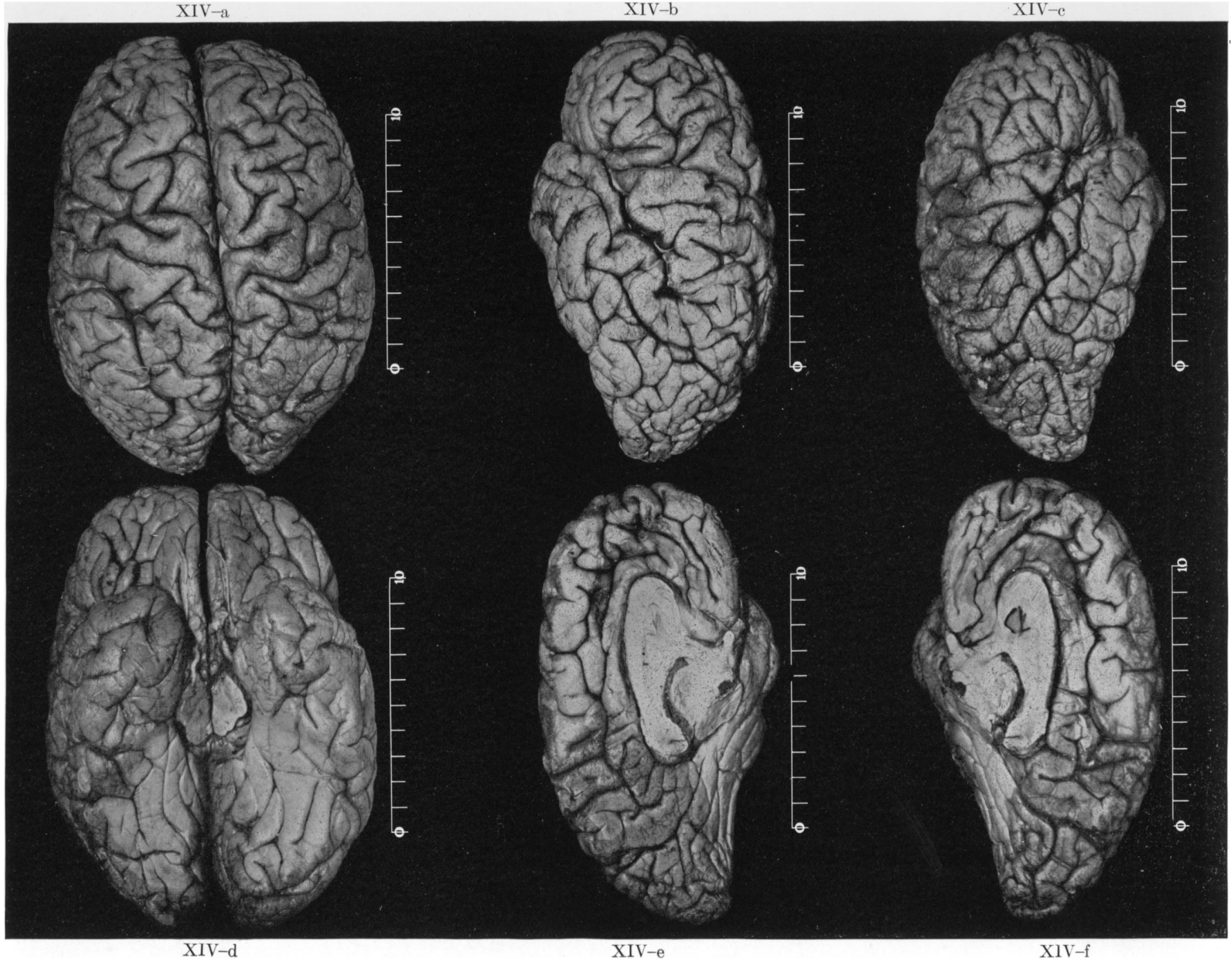


CASE XIII — MONGOLIAN IDIOT



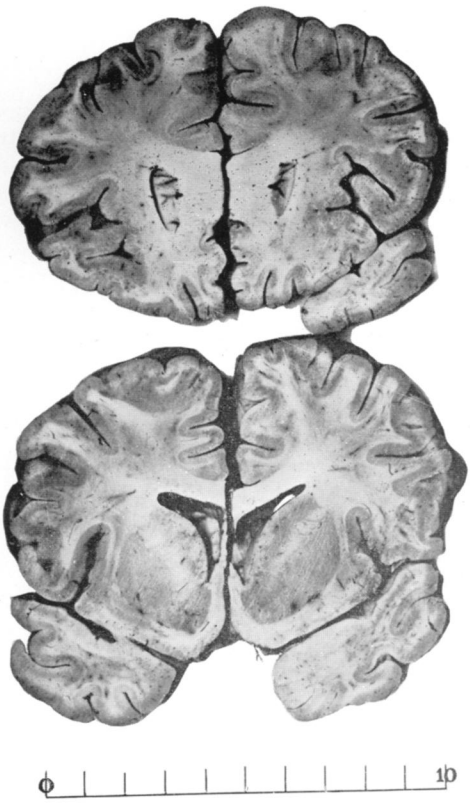
XIII–g XIII–h

CASE XIII — MONGOLIAN IDIOT



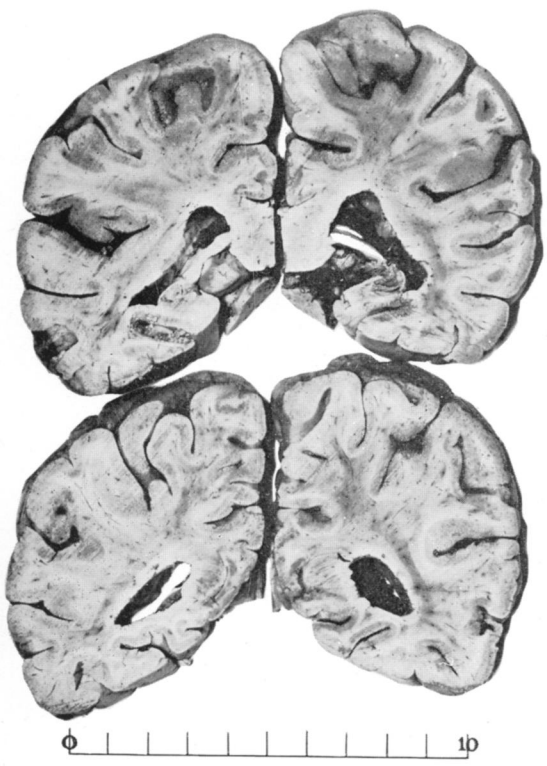
CASE XIV — IDIOT

XIV–g–h



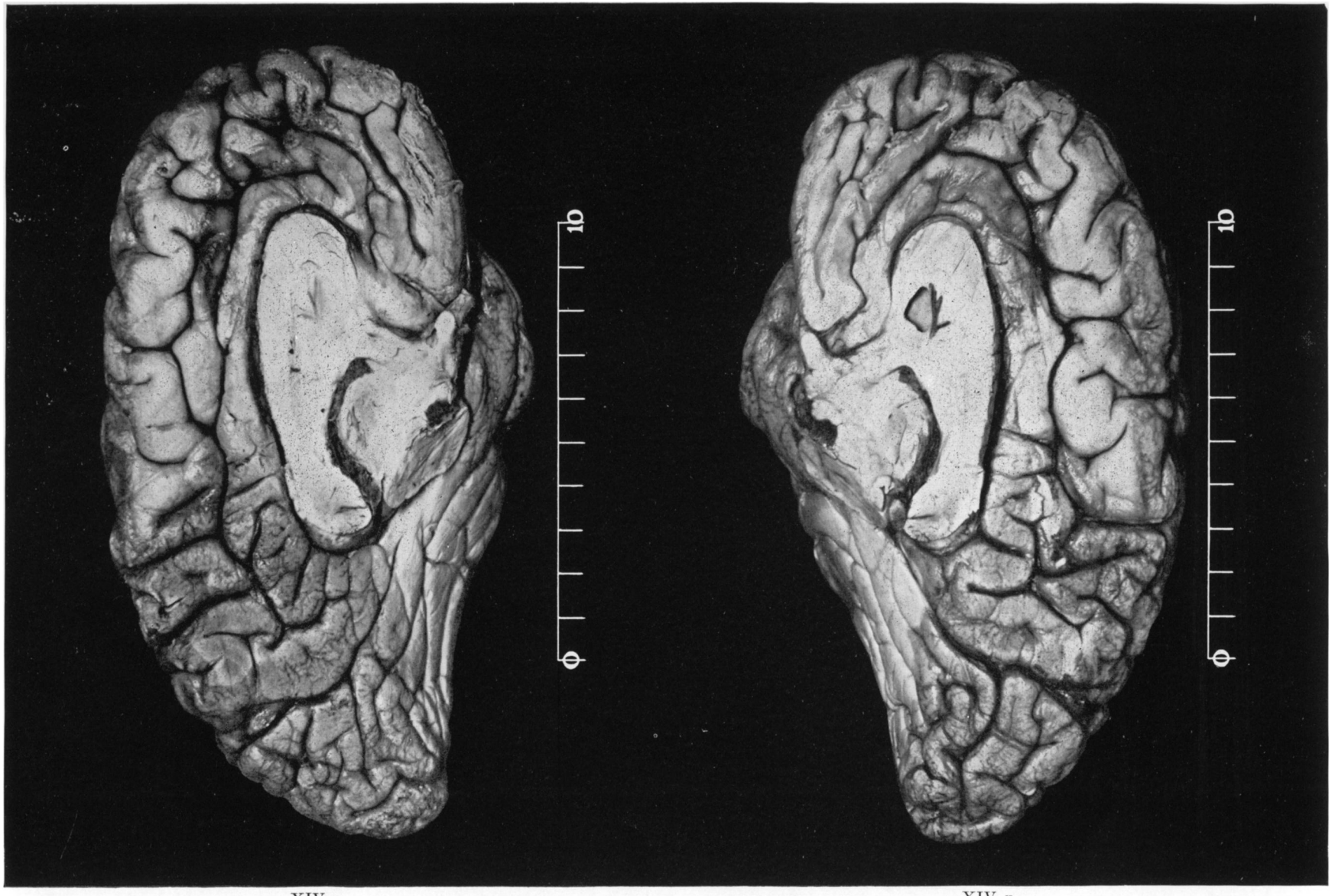
XIV–i–j

XIV–k–l



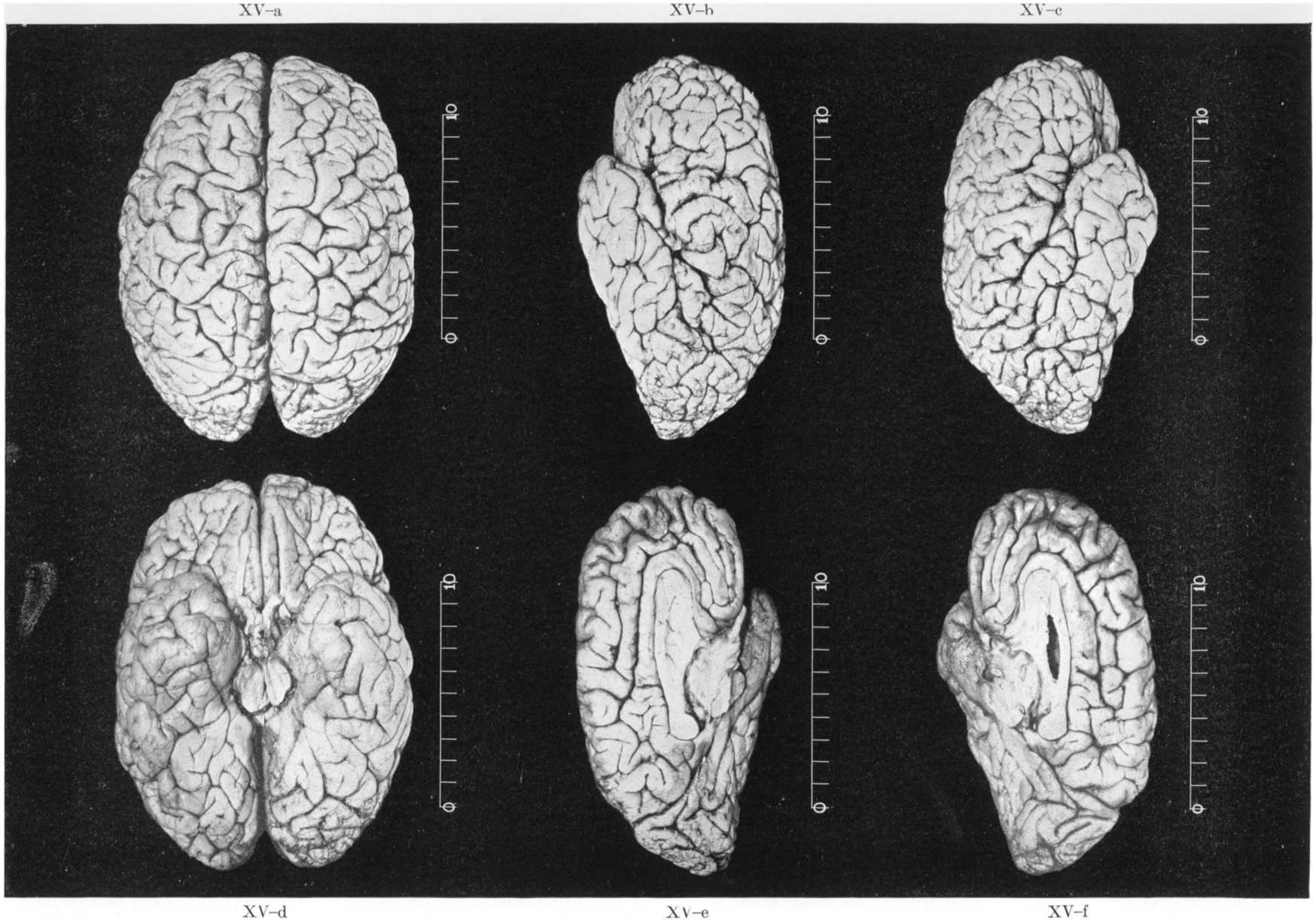
XIV–m–n

CASE XIV — IDIOT



XIV–o XIV–p

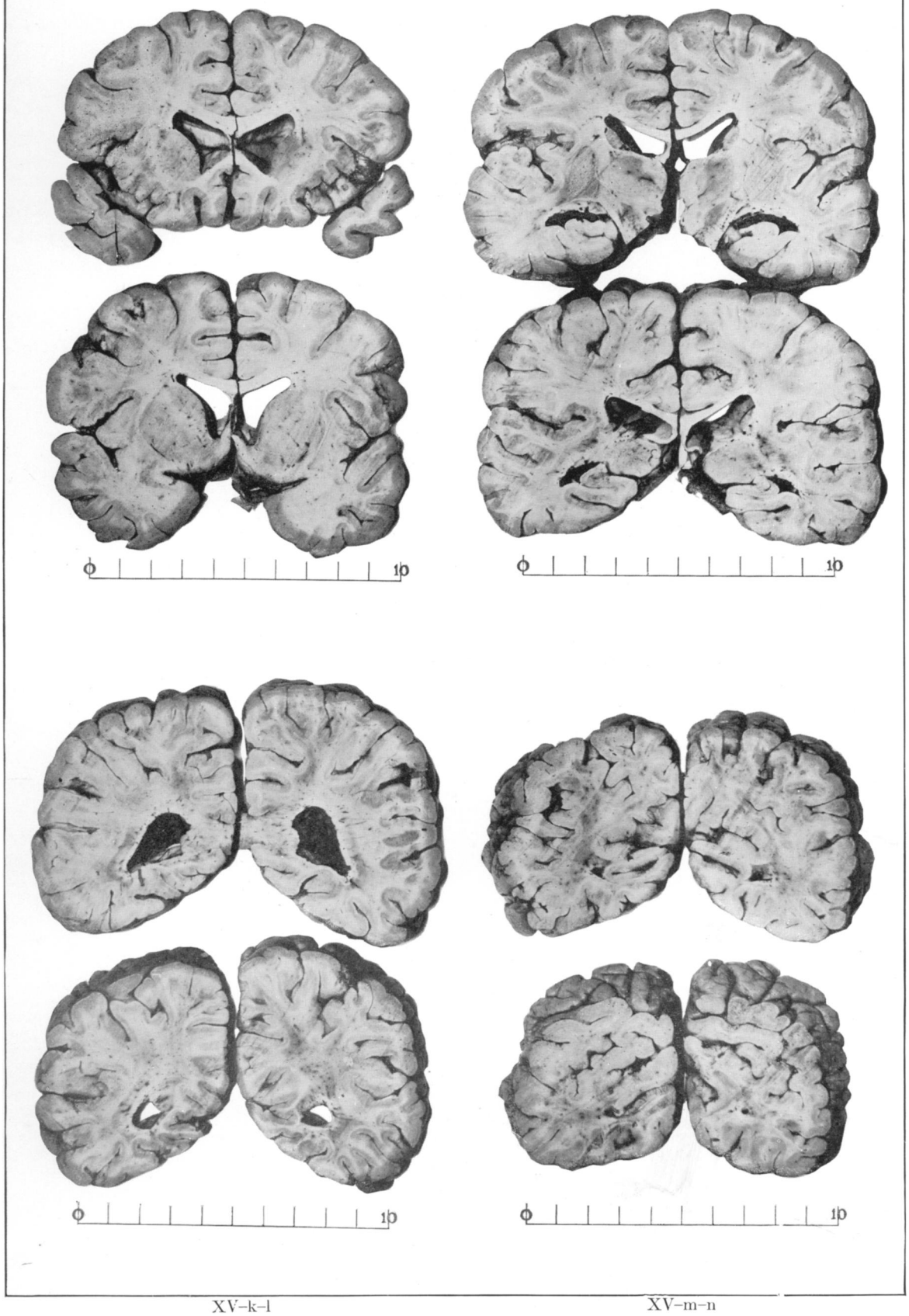
CASE XIV — IDIOT



CASE XV — IMBECILE

XV–g–h

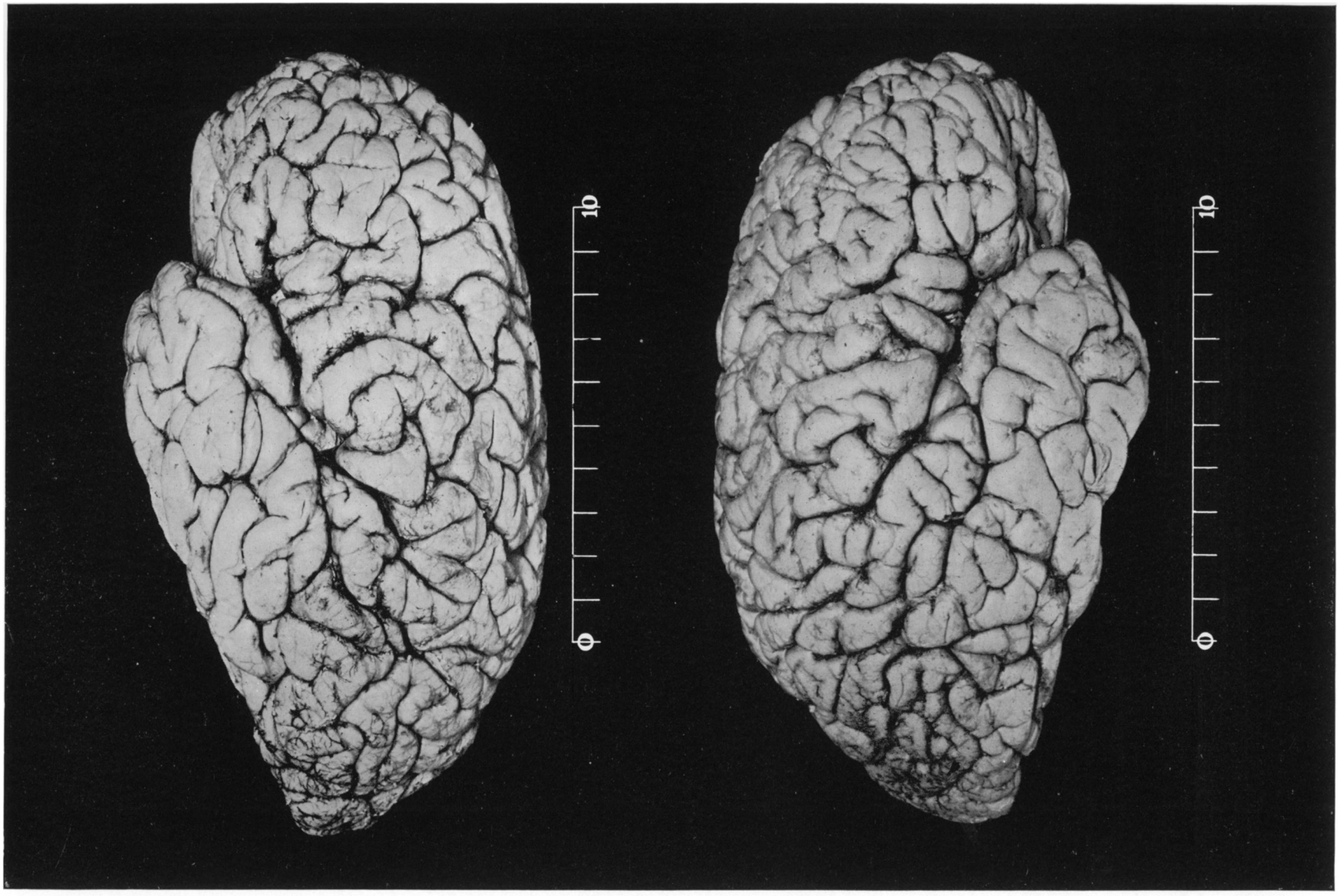
XV–i–j



XV–k–l

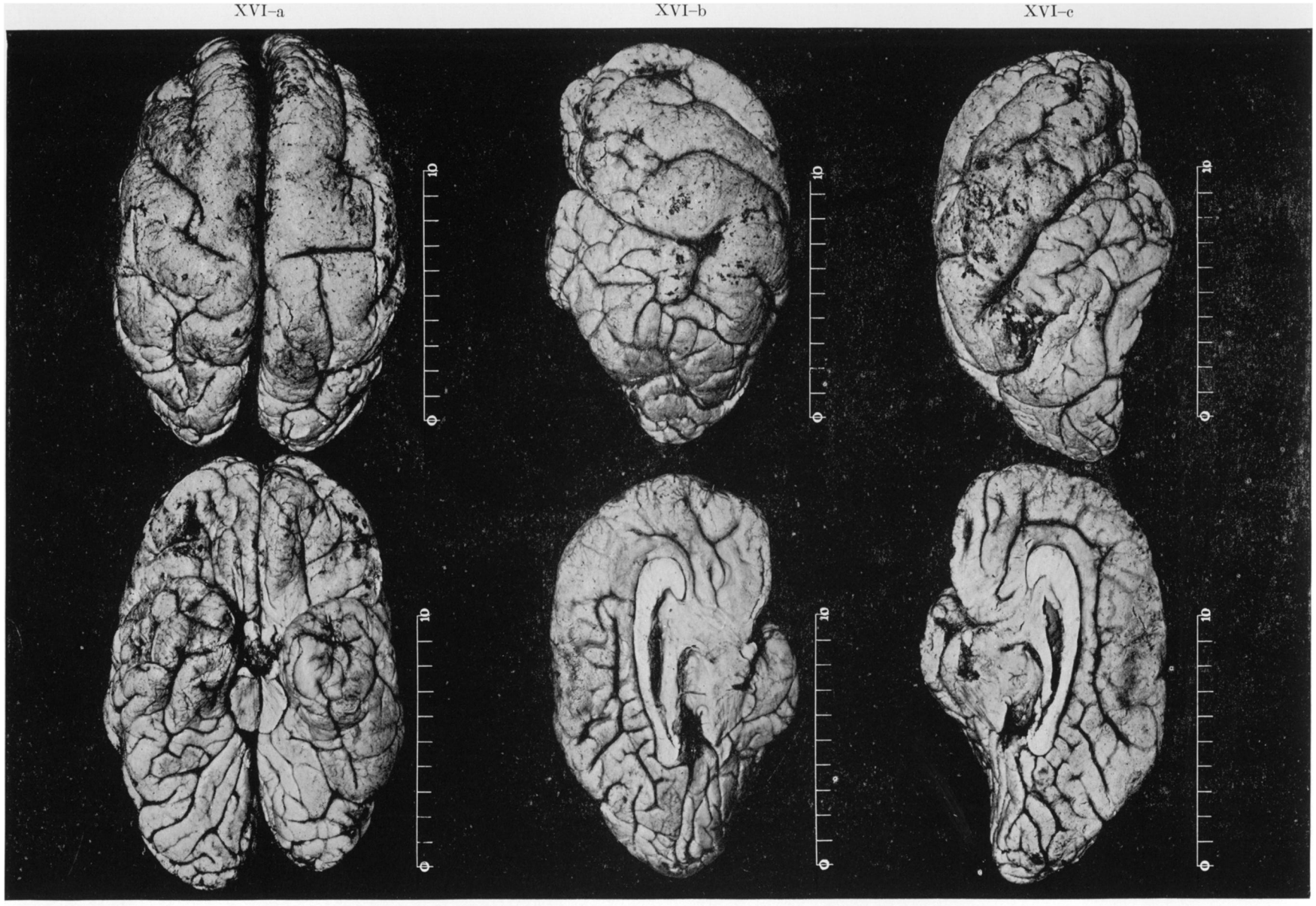
XV–m–n

CASE XV — IMBECILE



XV–o XV–p

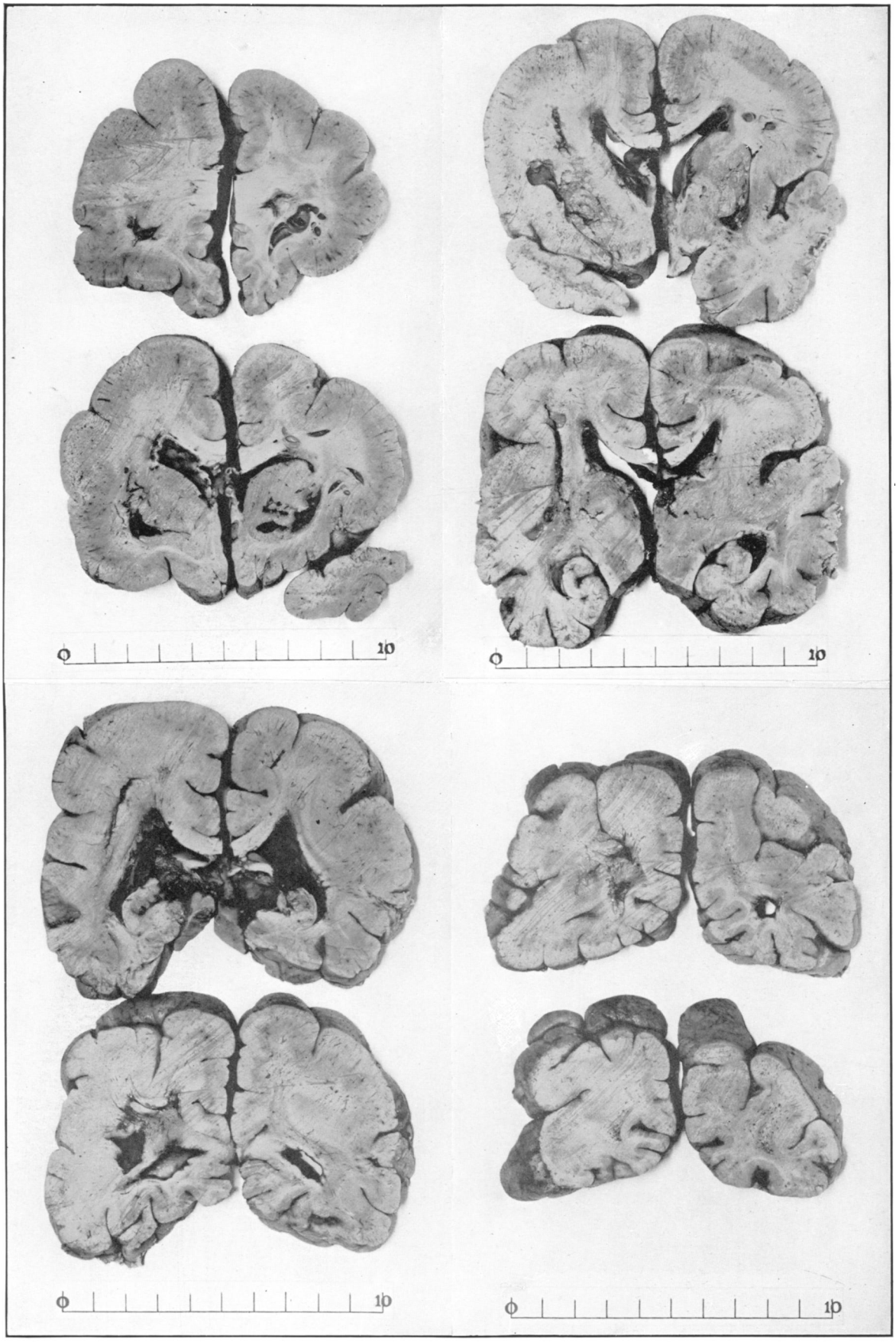
CASE XV — IMBECILE



CASE XVI — MACROGYRIA

XVI–g–h

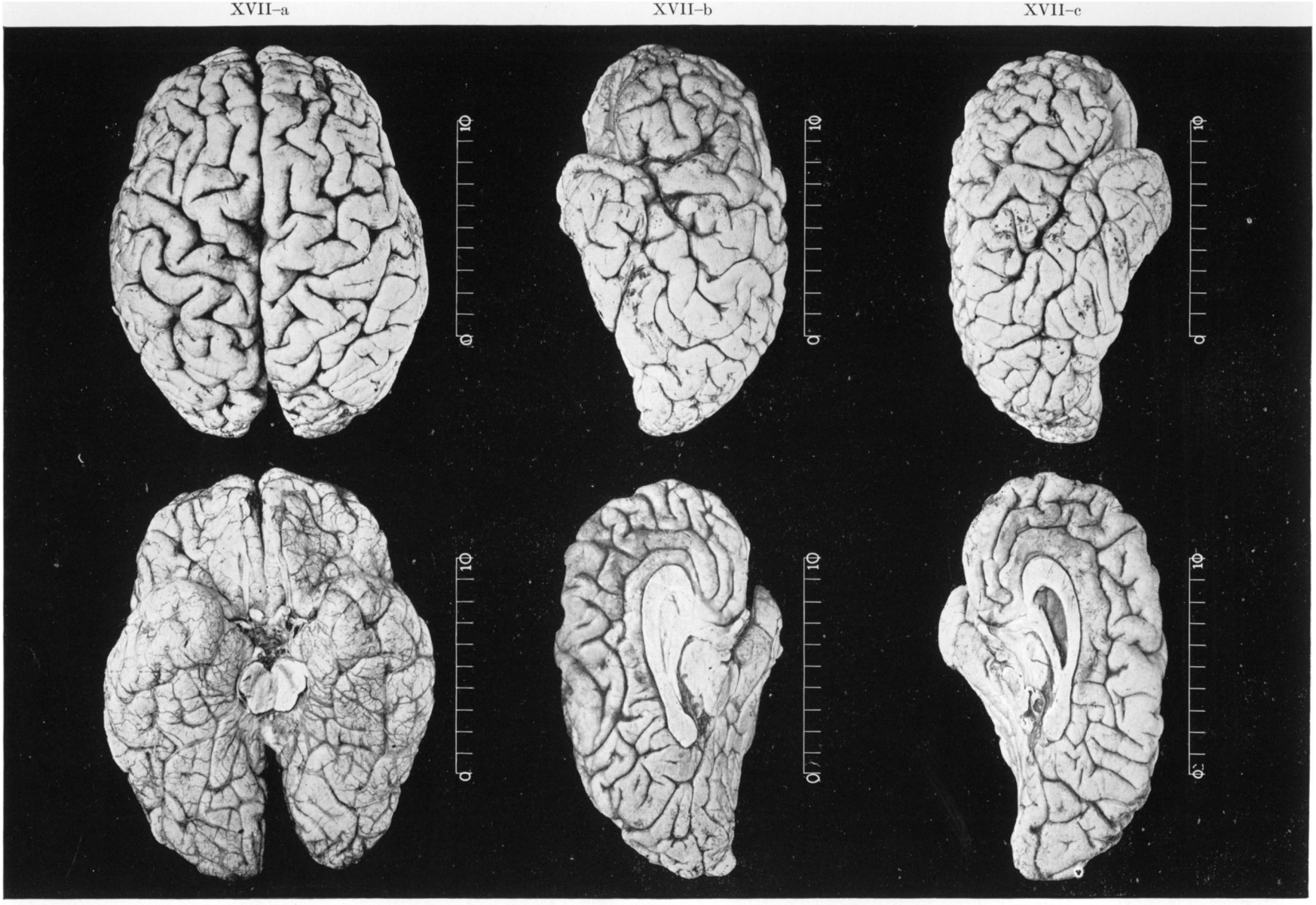
XVI–i–j



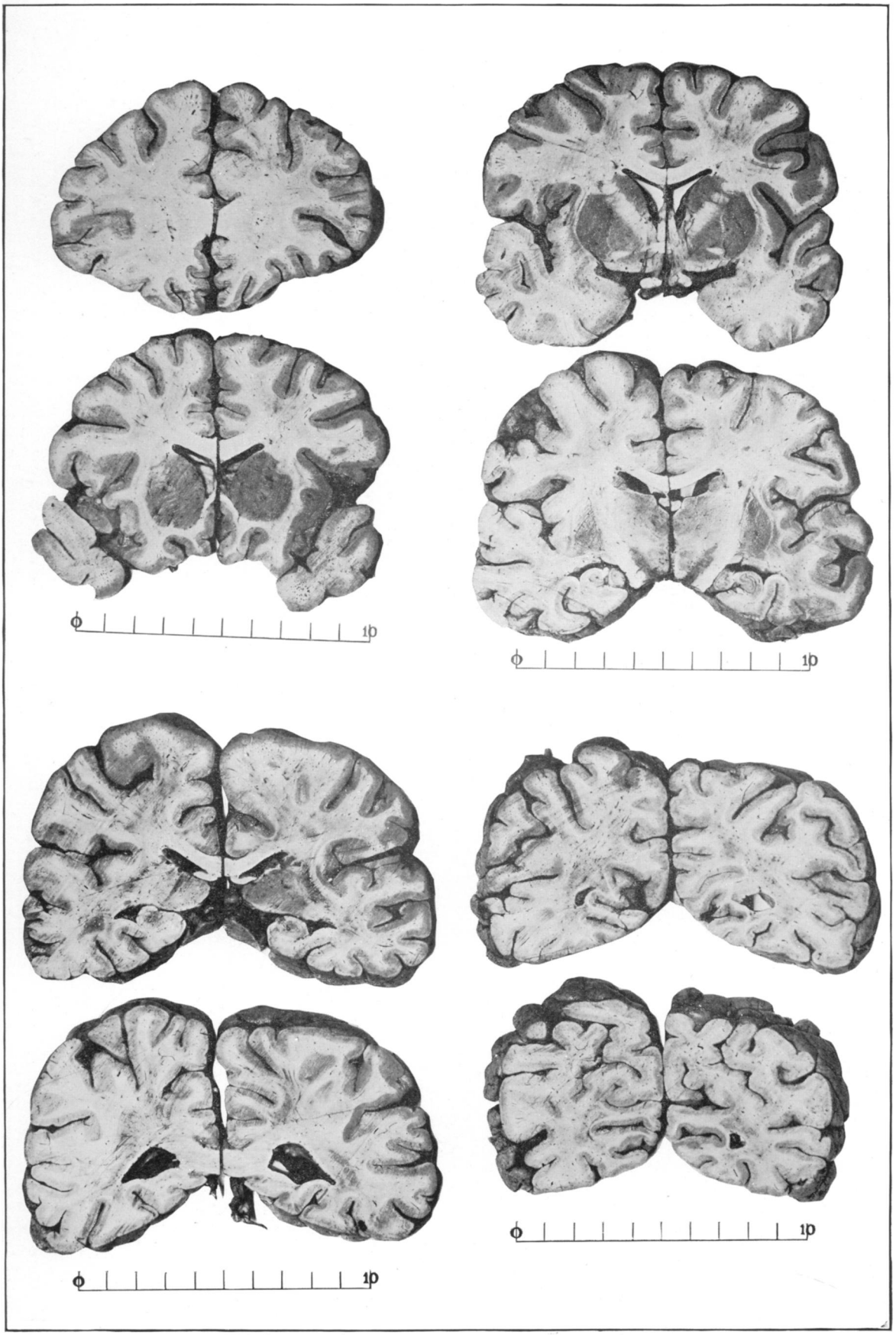
XVI–k–l

XVI–m–n

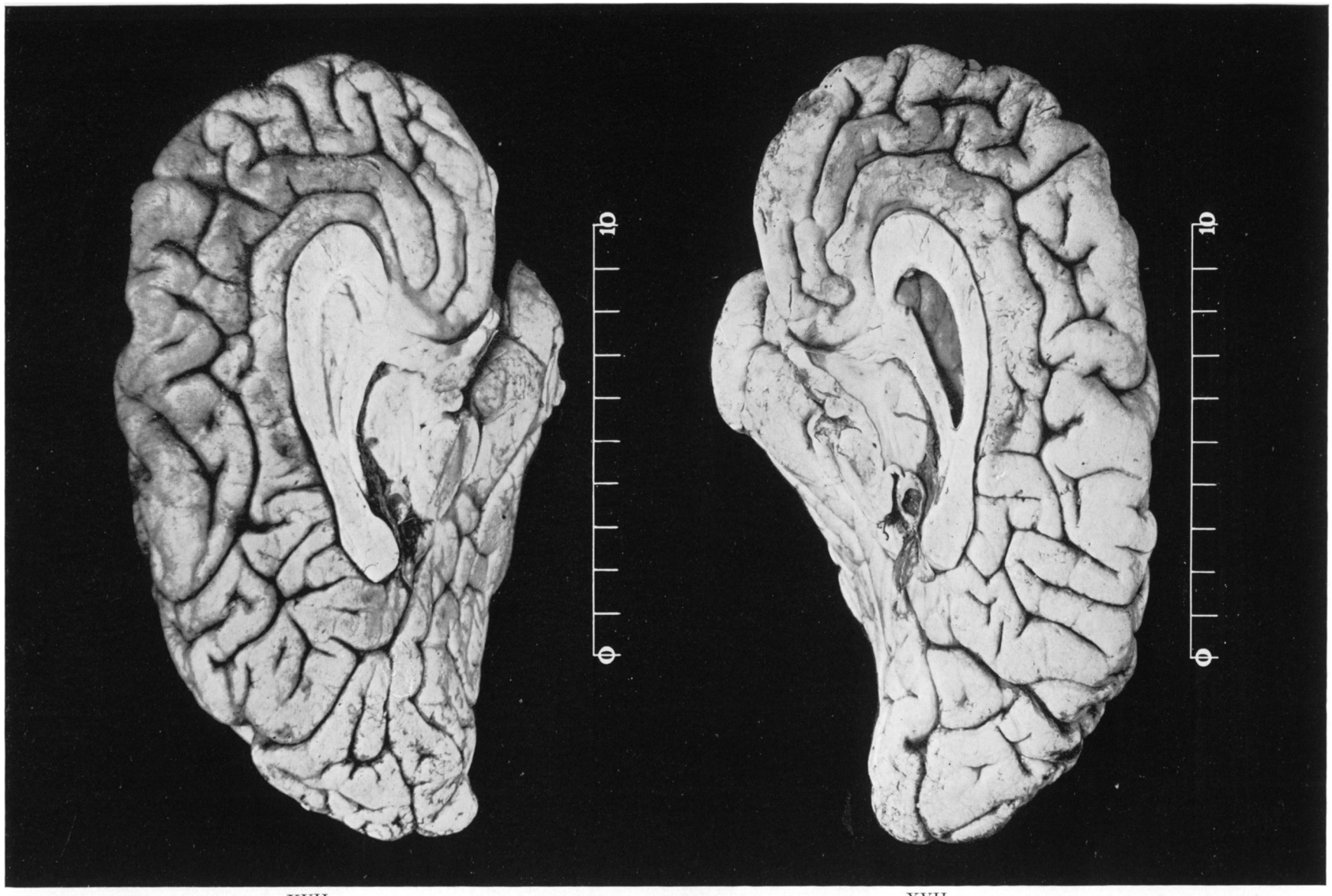
CASE XVI — MACROGYRIA



CASE XVII — IMBECILE

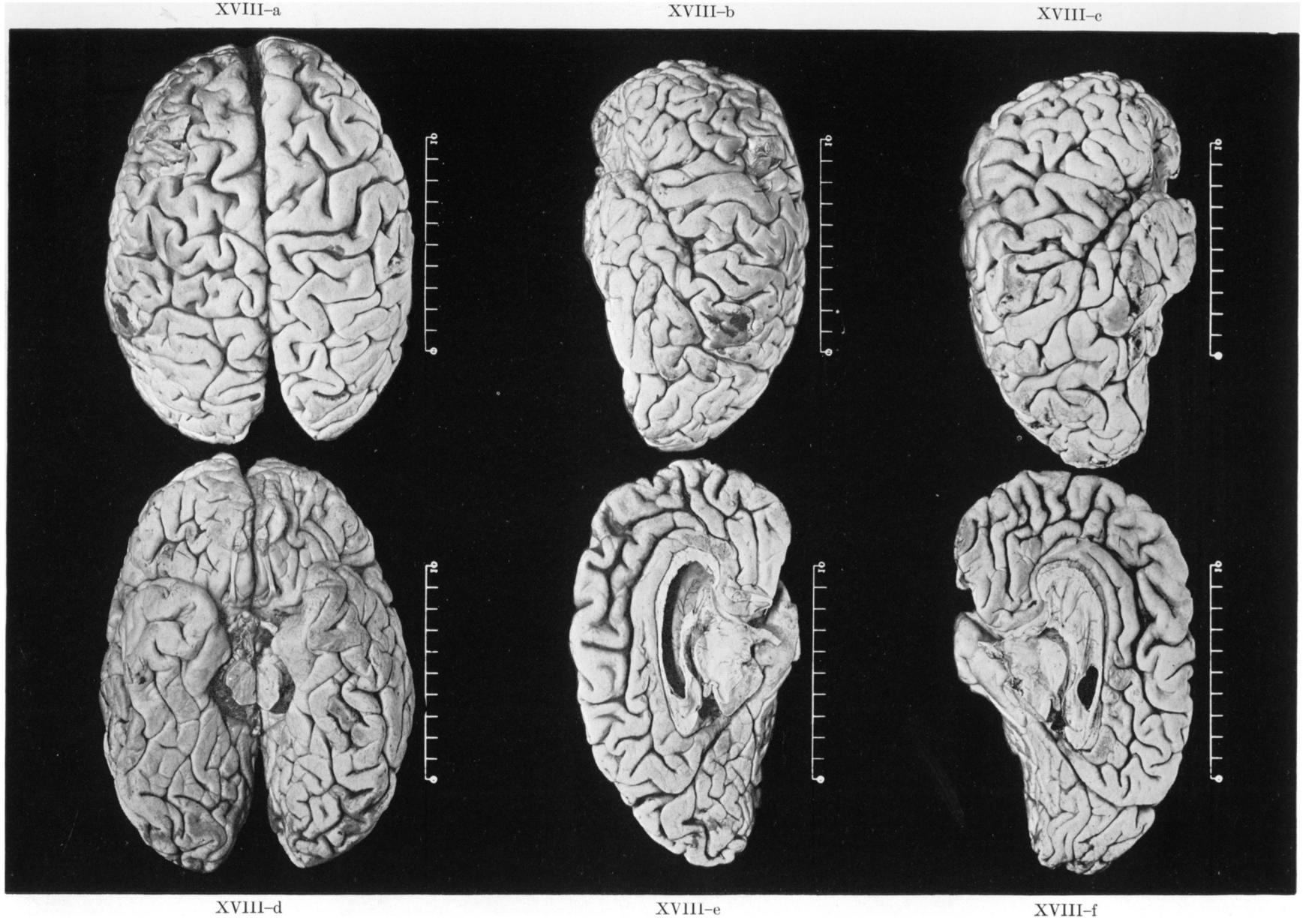


CASE XVII — IMBECILE



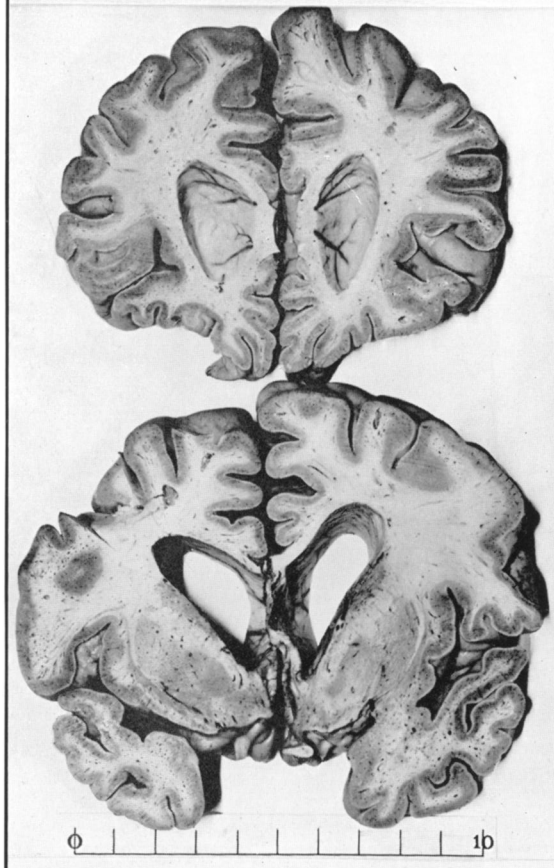
XVII–o XVII–p

CASE XVII — IMBECILE



CASE XVIII — IDIOT

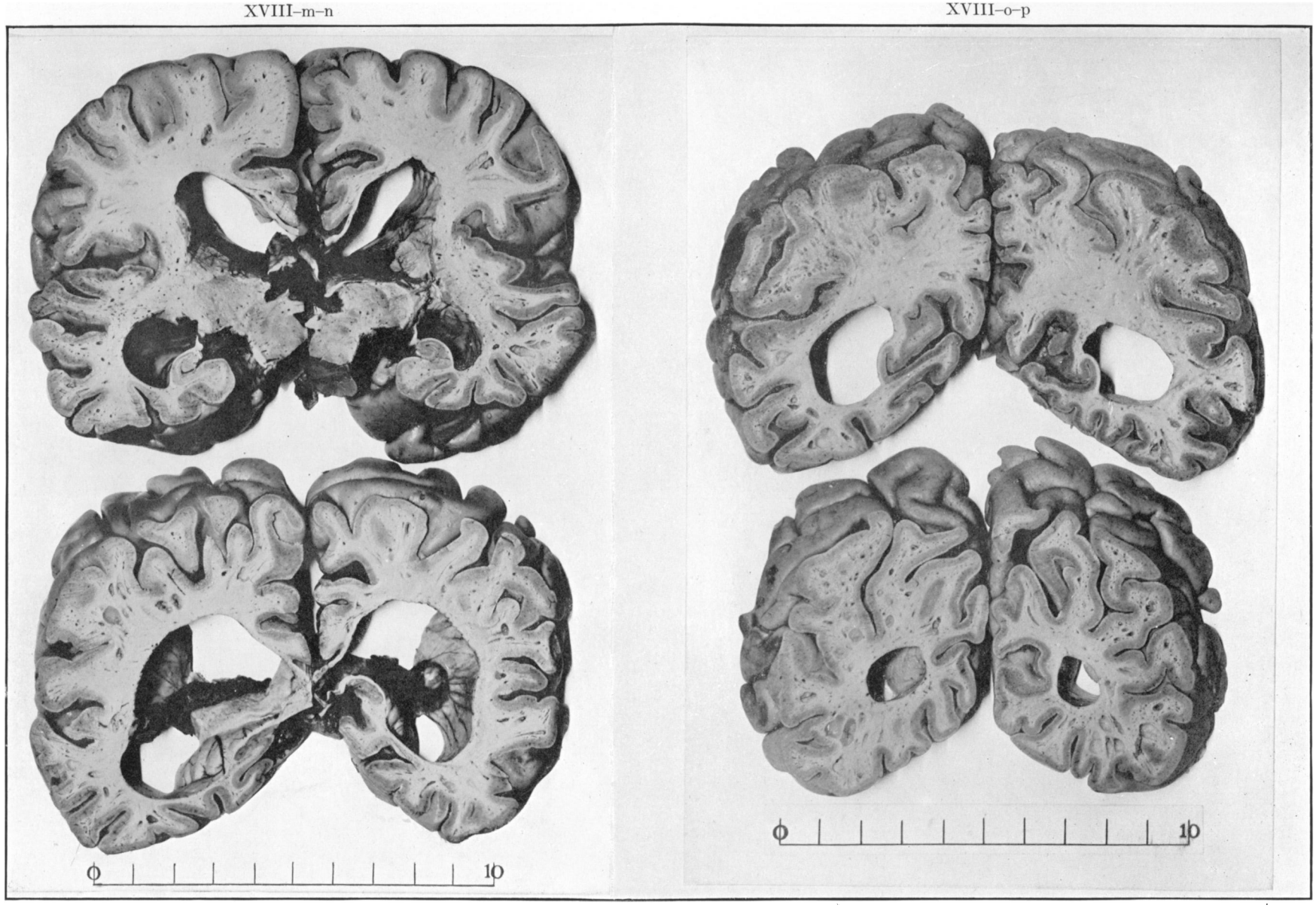
XVIII–g–h



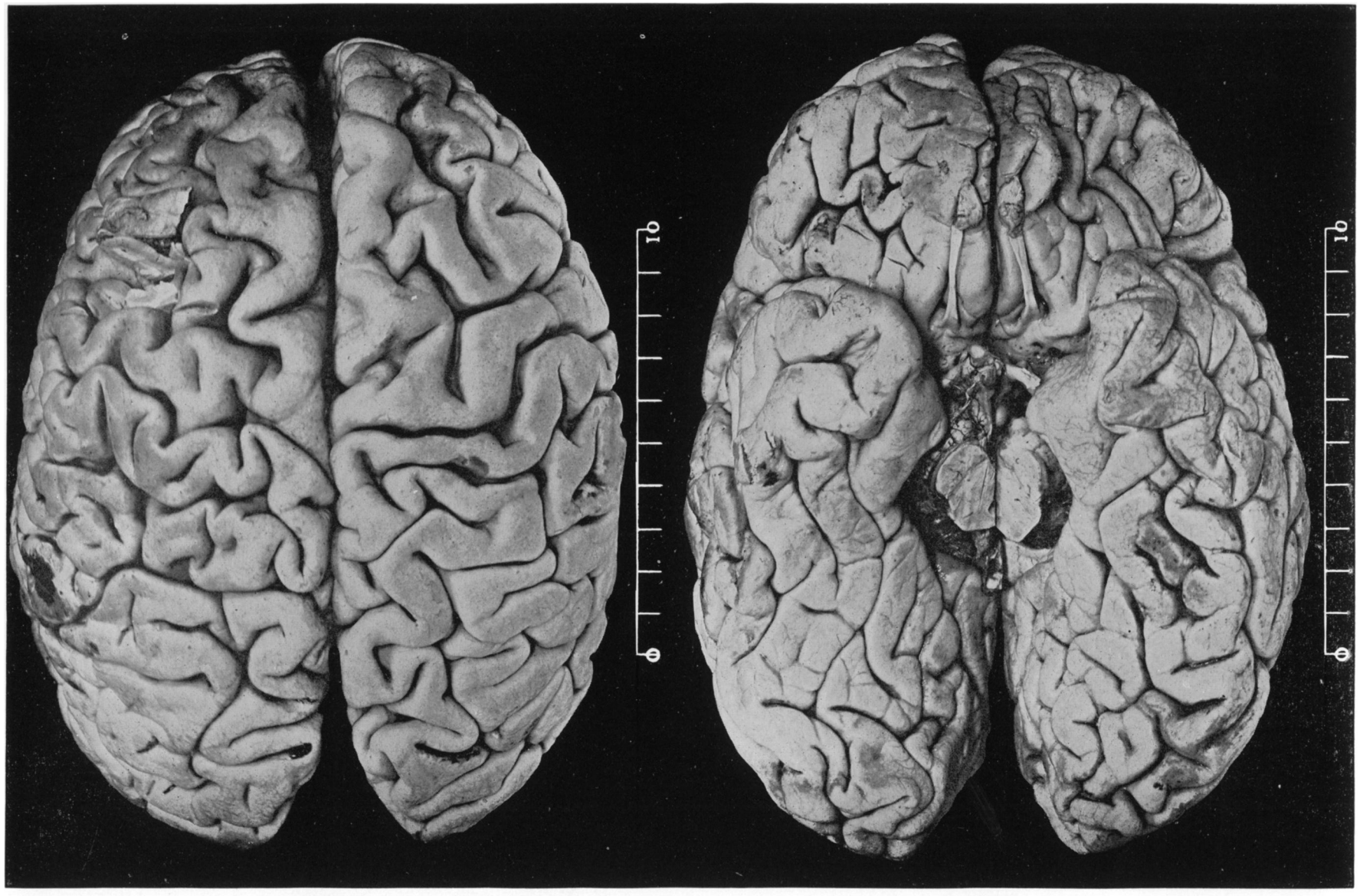
XVIII–i–j

XVIII–k–l

CASE XVIII — IDIOT

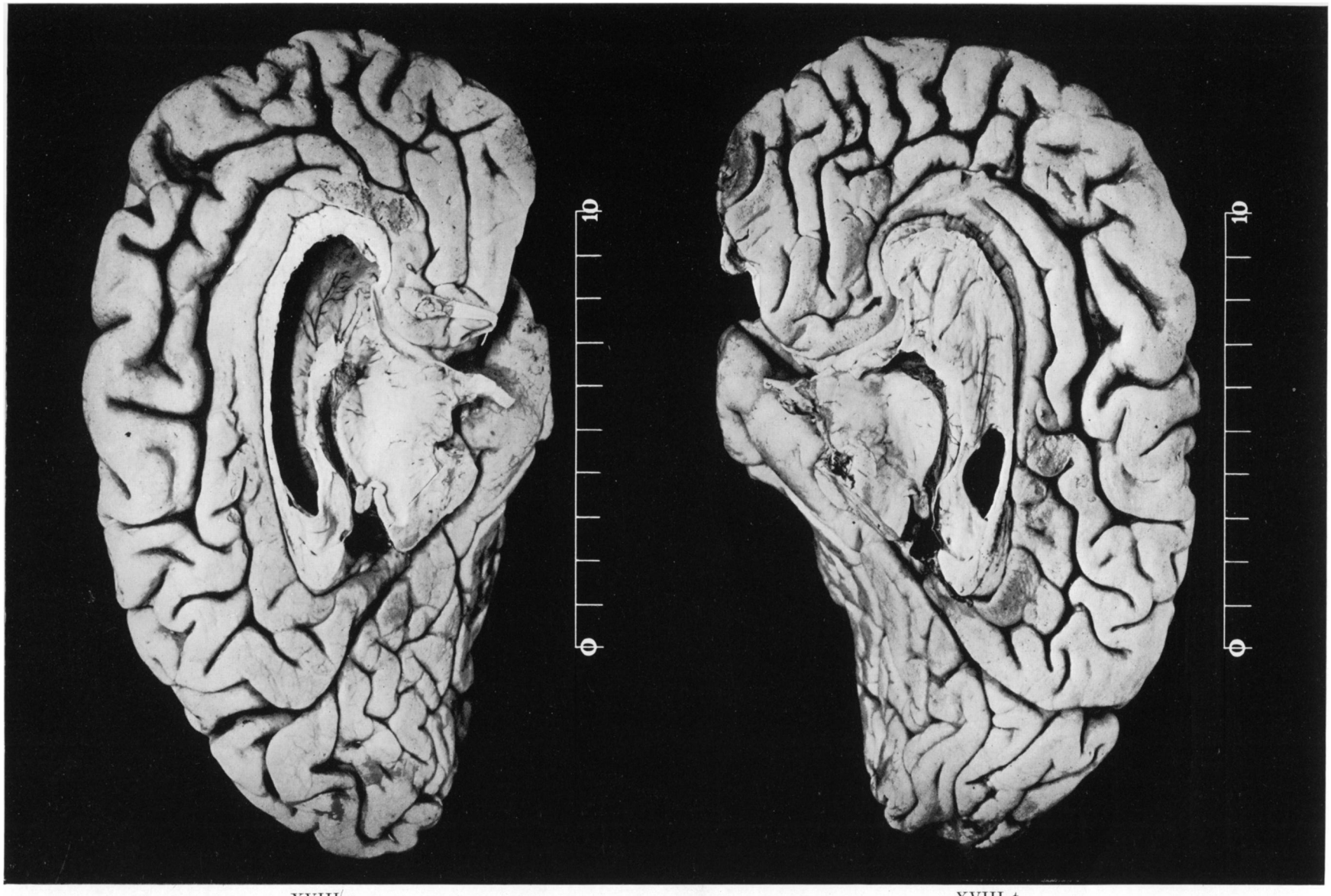


CASE XVIII — IDIOT



XVIII–q XVIII–r

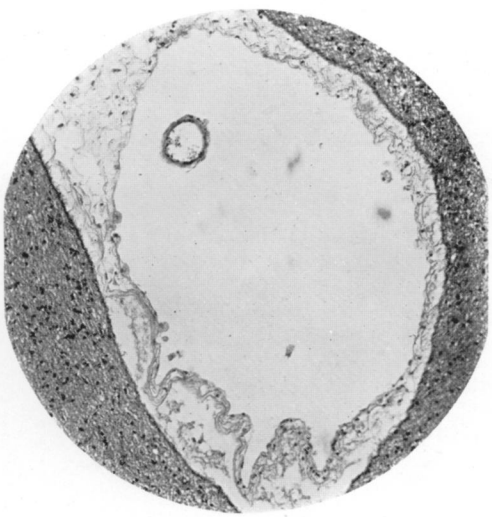
CASE XVIII — IDIOT



XVIII–s XVIII–t

CASE XVIII — IDIOT

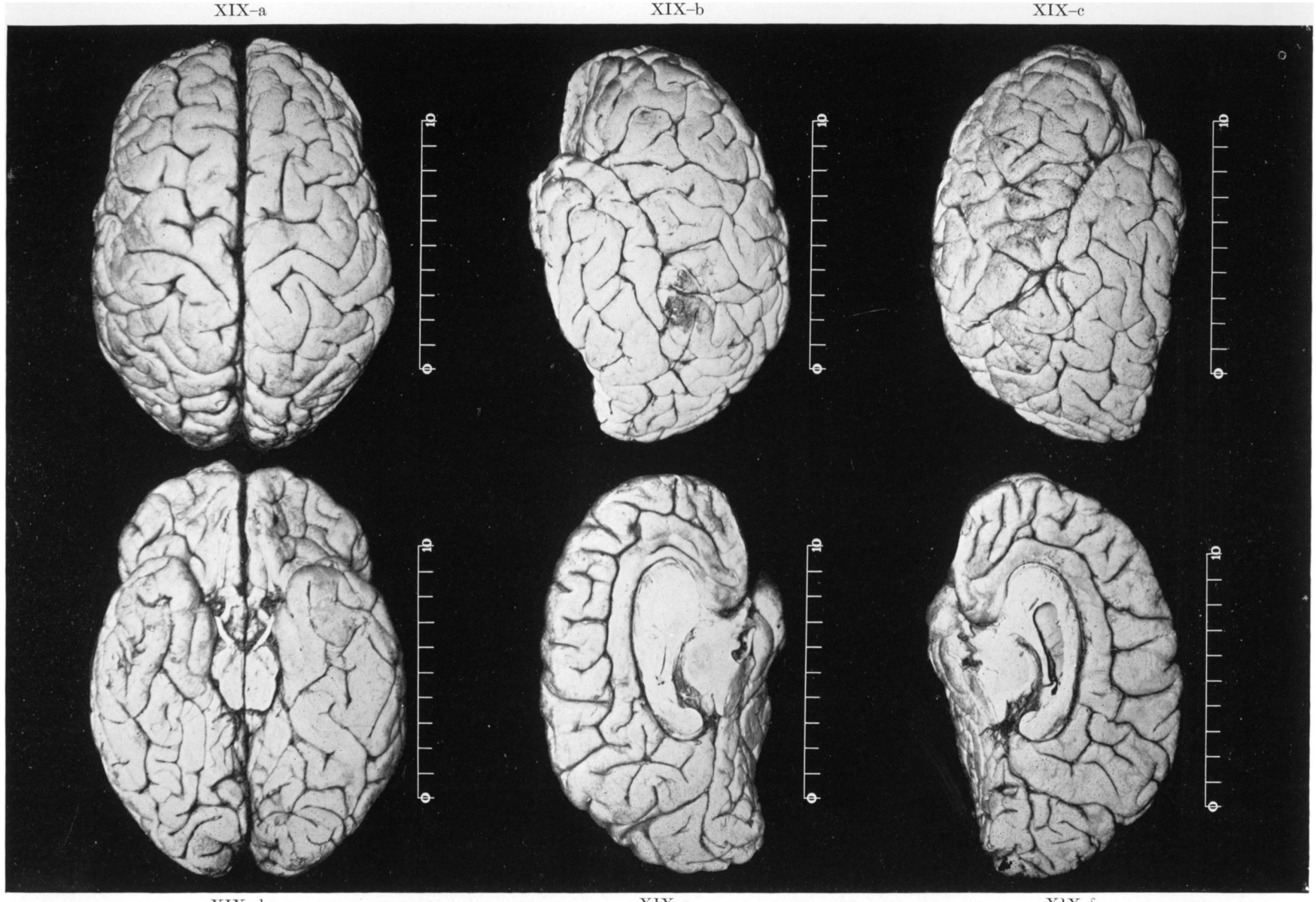
XVIII–u



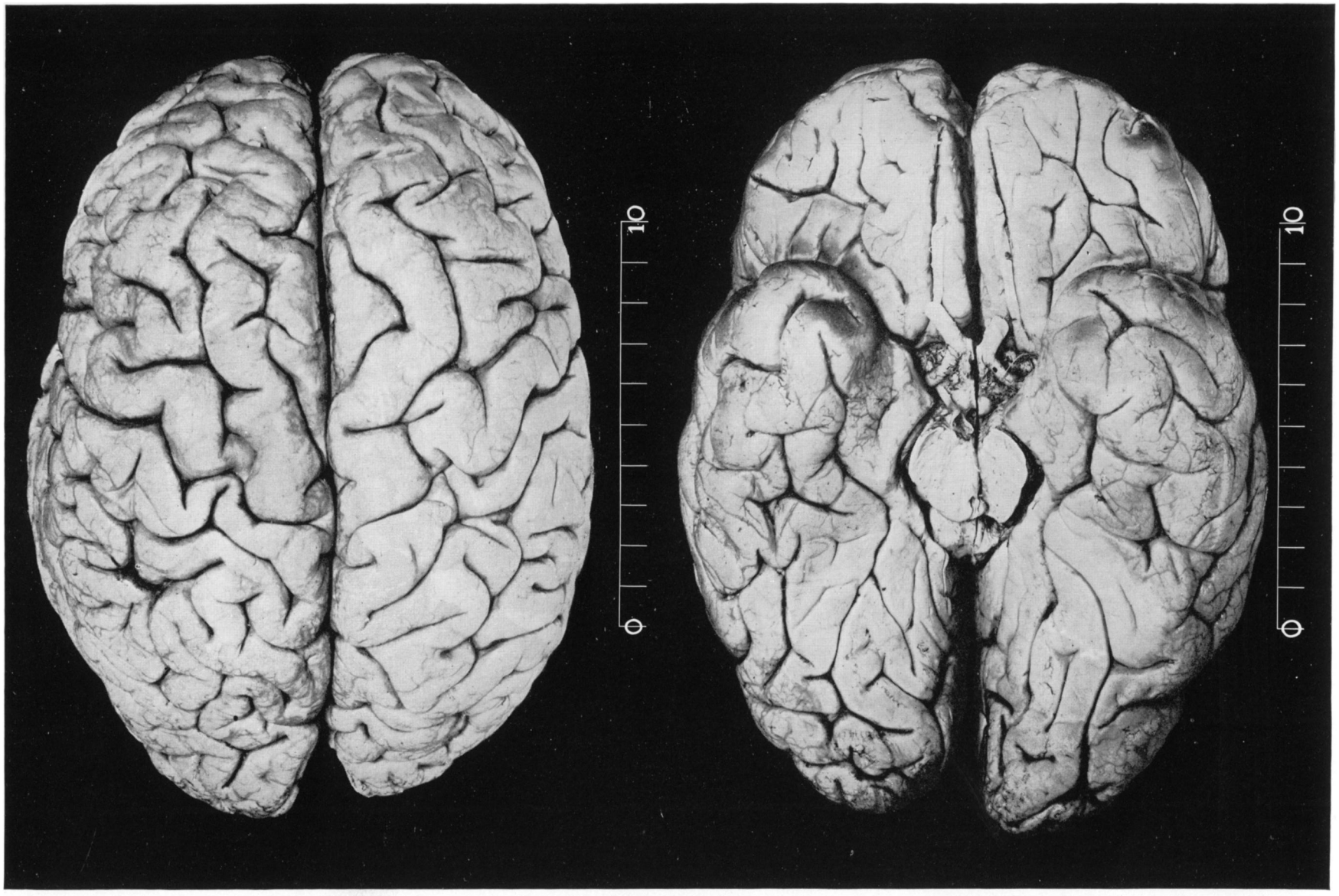
XVIII–v

XVIII–w

CASE XVIII — IDIOT



CASE XIX — MONGOLIAN

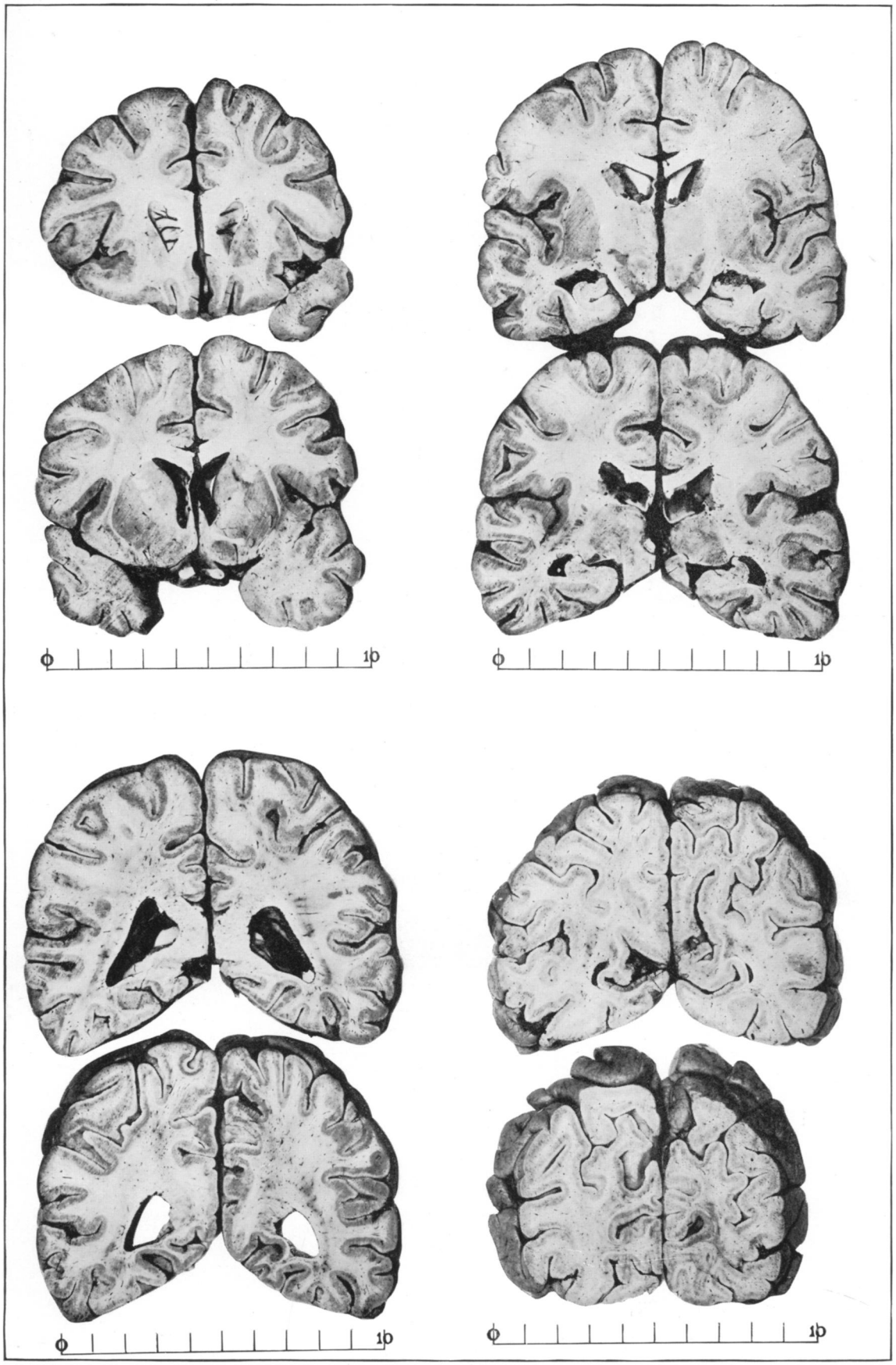


XIX-g XIX-h

CASE XIX — MONGOLIAN

XIX–i–j

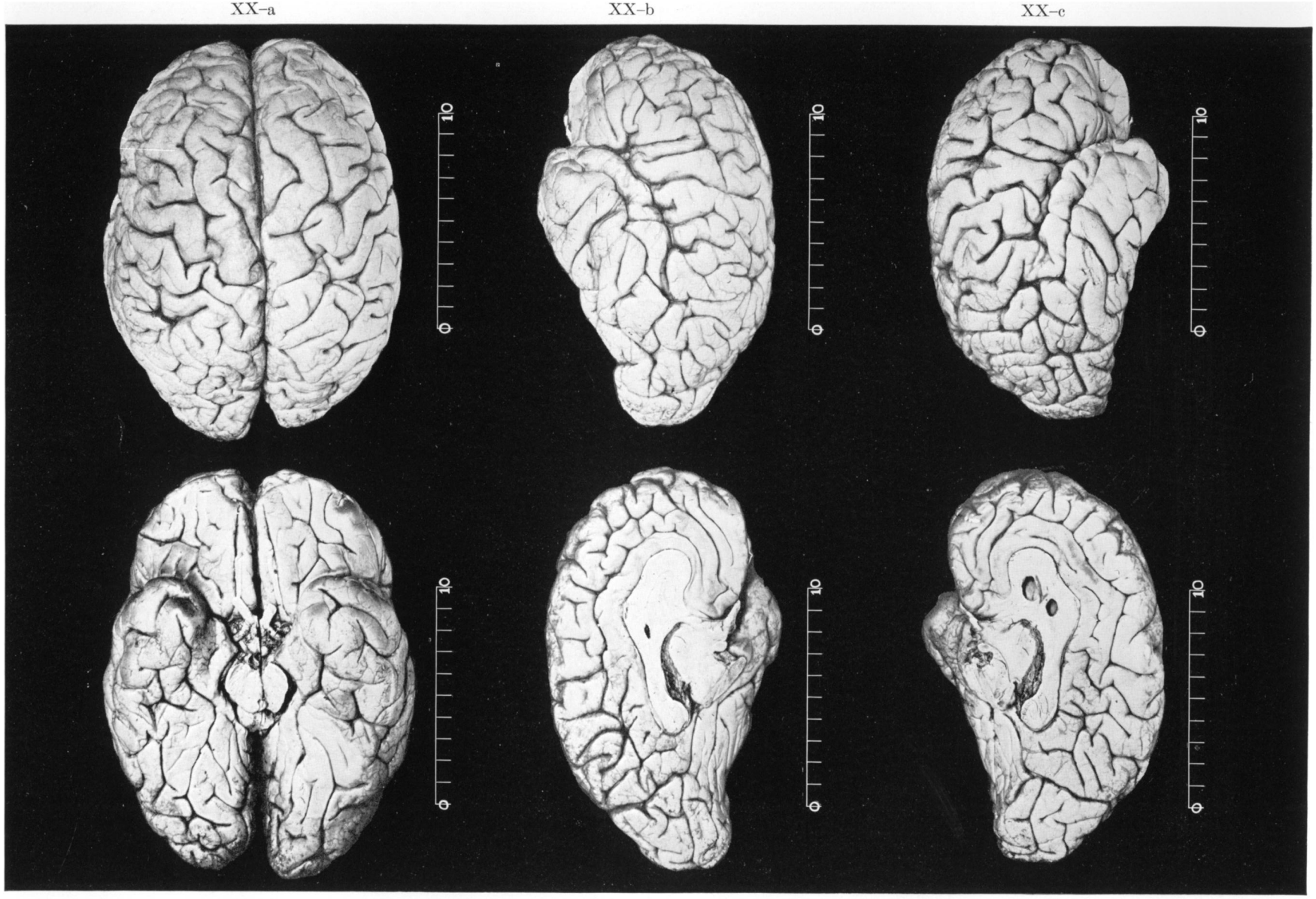
XIX–k–l



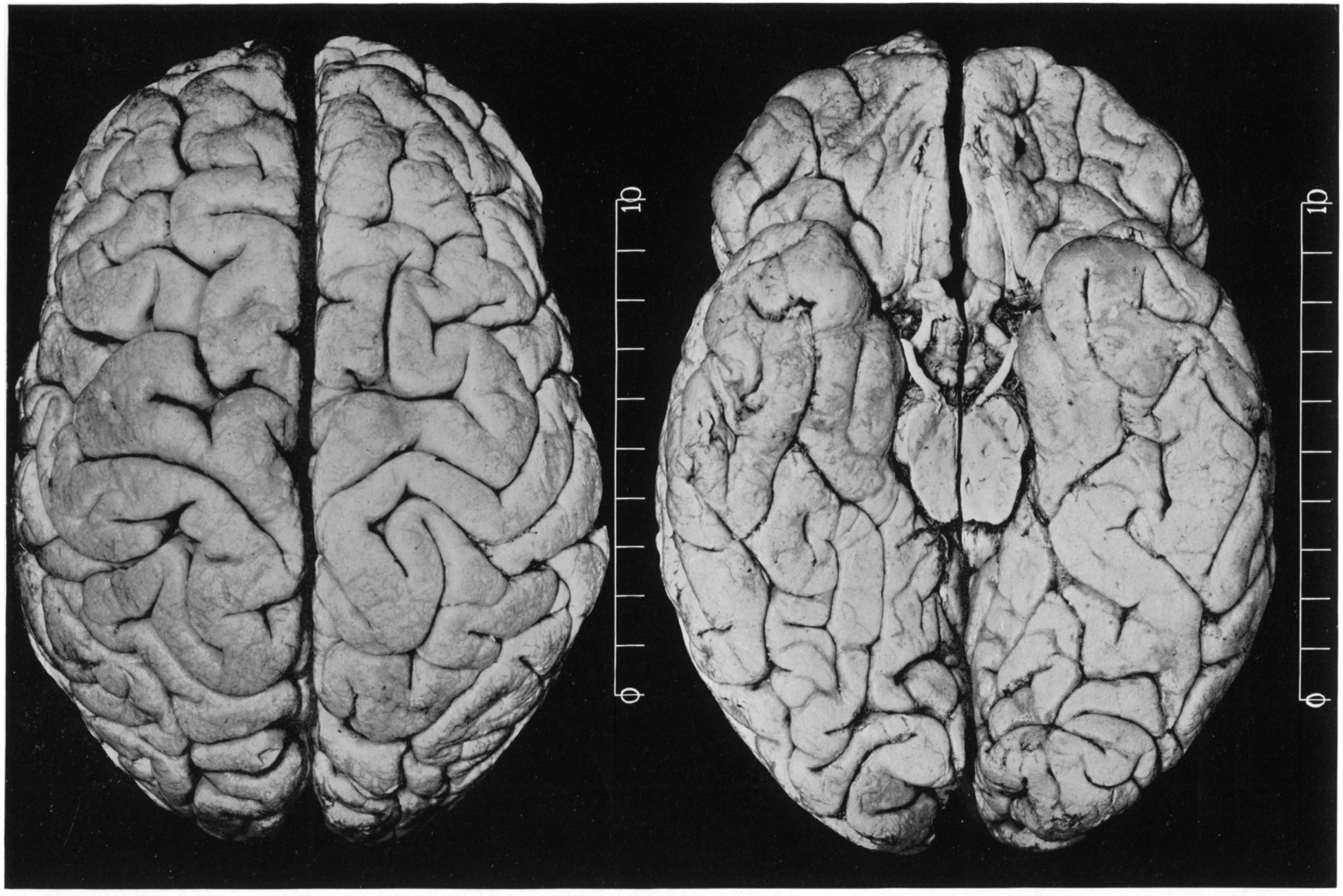
XIX–m–n

XIX–o–p

CASE XIX — MONGOLIAN



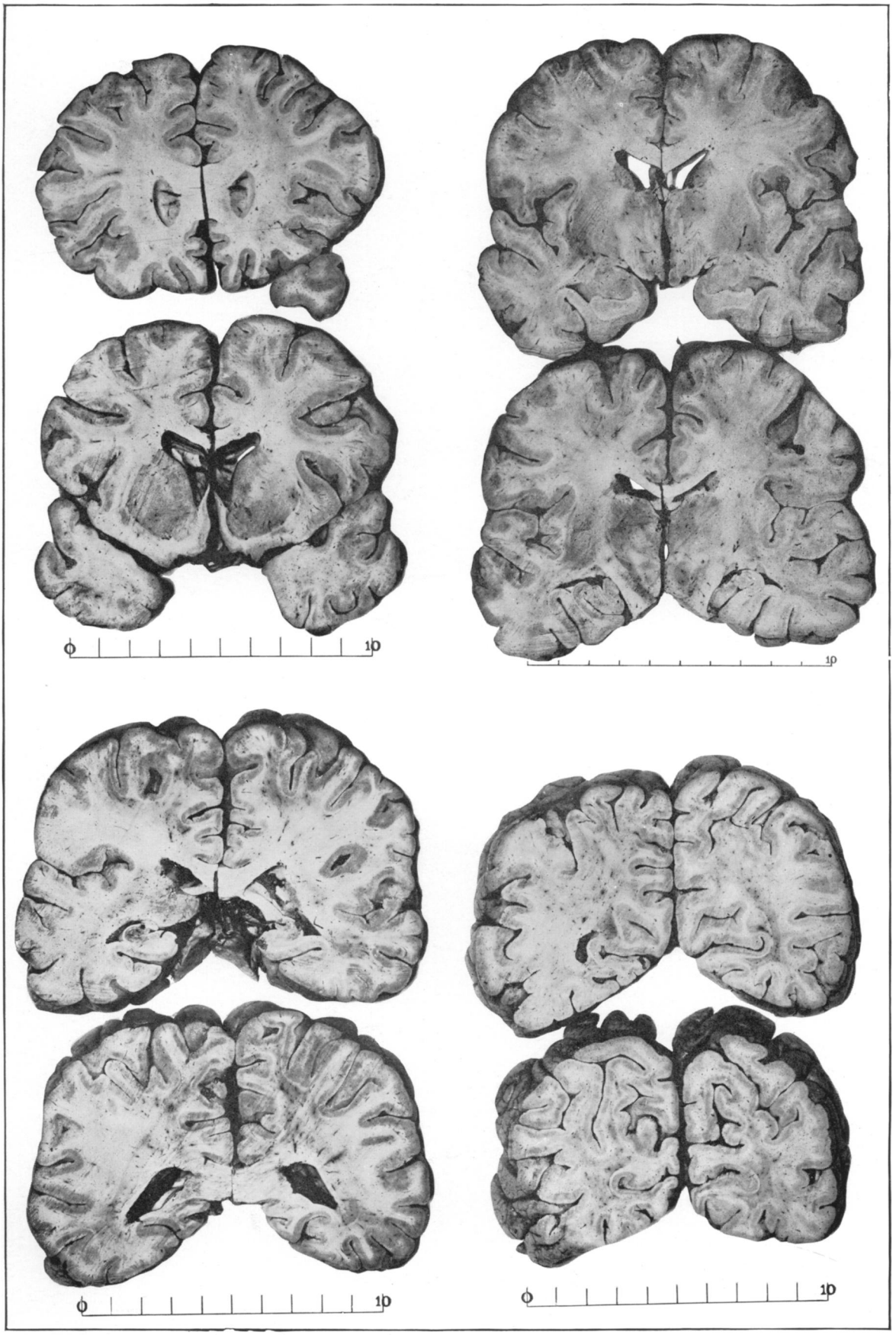
CASE XX — INSANE IMBECILE



XX–g XX–h

CASE XX — INSANE IMBECILE

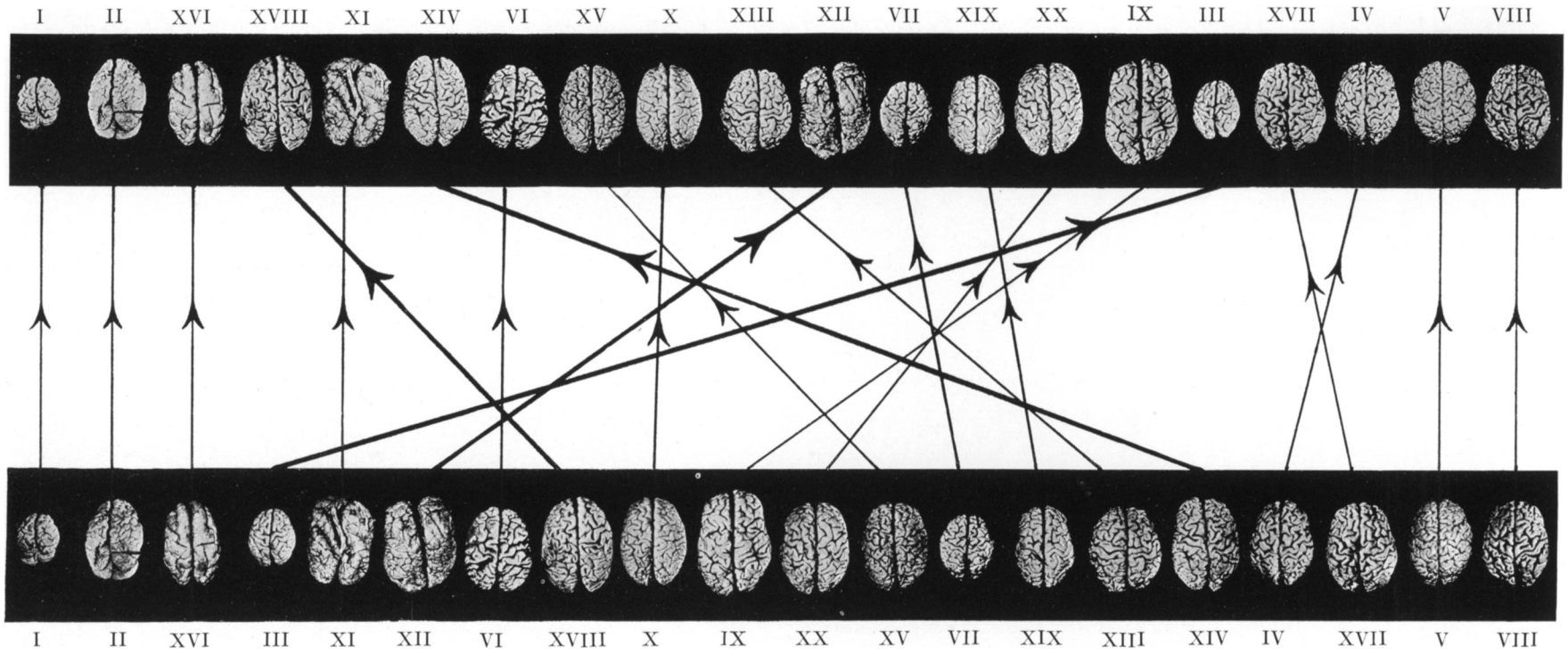
XX-i-j XX-k-l



XX-m-n XX-o-p

CASE XX — INSANE IMBECILE

INTELLECTUAL ORDER (Binet — See Table XI)



ANATOMICAL ORDER (Brain Complexity — See Table IX)